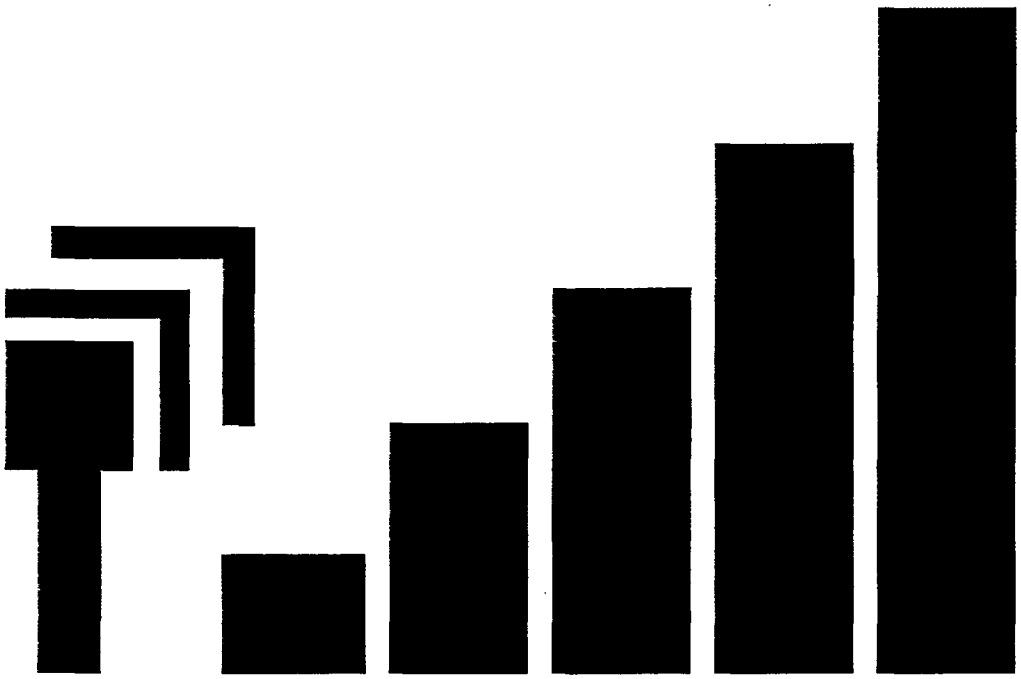
U.S. Department of Justice
Federal Bureau of Investigation
Operational Technology Division

WIRELESS EVOLUTION



1G - ANALOG | 2G - DIGITAL | 3G - HIGH SPEED IP DATA | 4G - ALL - IP PACKET-SWITCHED

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MESSAGE FROM MANAGEMENT

b7E

The boundaries of technology are constantly expanding. Recognizing the pathway of emerging technology is a key element to maintaining relevance in a rapidly changing technological environment. While this proficiency is fundamentally important in developing strategies that preserve long-term capabilities in the face of emerging technologies, equally important is delivering technical solutions to meet the operational needs of the law enforcement customer in a dynamic 'threat' environment. How can technical law enforcement organizations maintain the steady-state production of tools and expertise for technical collection, while infusing ideas and agility into our organizations to improve our ability to deliver timely, relevant, and cutting edge tools to law enforcement customers? Balancing these two fundamentals through an effective business strategy is both a challenge and an opportunity for the Federal Bureau of Investigation (FBI) and other Federal, state, and local law enforcement agencies.

This edition of the Emerging Technologies Research (ETR) Bulletin examines wireless technology

In the last decade, smartphone technology and the ability to communicate data over handheld and other portable devices have grown exponentially. Simple Personal Digital Assistants (PDAs) have been replaced with the iPhone, Android, and other Global Positioning System (GPS) enabled hybrid devices.

When we consider strategies to mitigate risks posed by emerging technologies, the FBI and our law enforcement partners

While this broad approach may be a sound strategy for long-term development,

As an alternative, consider the opportunity to employ a customer-centric business strategy that combines technology, innovation, and collaboration. This strategy was recently incorporated into the FBI's efforts to develop technical tools to combat threats along the Southwest Border.

The customer-centric approach calls for a high degree of collaboration among engineers, subject matter experts (SMEs), and the investigator to determine needs and requirements. To encourage innovation, the technologists gain a better understanding of the operational and investigative needs and tailor the technology to fit the end user's challenges. Rather than developing solutions from scratch, the customer-centric approach leverages and modifies the technology to fit the customer's needs.

Organizations that have traditionally been successful in vertical lines of production (sometimes referred to as stovepipes) can also benefit from an injection of this type of horizontal "internal consultancy" to jumpstart their capabilities. One way to implement this customer-centric business strategy is to empower a team of engineers and SMEs with the latitude to work across multiple departments, selecting those technologies that best fit the customer's needs. By setting the customer's requirements as the end goal, the internal and external collaboration is driven by the user's requirements. The unique tool or capability derived from this process is the product of the collaboration.

As law enforcement moves forward into the 21st century, emerging technologies such as Long Term Evolution (LTE) and other wireless technologies

The concepts of innovation and collaboration focused on the customer's requirements are not limited to technology. These principles can help deliver relevant technical solutions successfully, especially when the technology is changing at such a rapid pace. We can count on technology to change. Our strategy for dealing with this change can make a difference in the technical tools we provide our Federal, state, and local law enforcement customers.

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Mr. Bryars entered on duty as a Special Agent with the FBI in 1987 and reported to the Kansas City Division and investigated a variety of criminal matters, to include Violent Crime, White Collar Crime and Organized Crime/Drug investigations. He also served in the Kansas City technical program as a Technical Agent in training. In 1994, he was transferred to the Miami Division where he investigated Public Corruption and served as a primary member of the Miami Division Special Weapons and Tactics team. ***Continued on page 71***

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2. THE FCC'S NET NEUTRALITY RULES

EXECUTIVE SUMMARY

On December 21, 2010, the Federal Communications Commission (FCC) approved new rules aimed at regulating how broadband service providers offer individuals and organizations the ability to access the Internet. The FCC's goal was to, "...provide greater clarity and certainty regarding the continued freedom and openness of the Internet." In doing so, it adopted four basic principles:

- Transparency. Fixed and mobile broadband providers must disclose the network management practices, performance characteristics, and terms and conditions of their broadband services;
- No Blocking. Fixed broadband providers may not block lawful content, applications, services, or non-harmful devices; mobile broadband providers may not block lawful websites, or block applications that compete with their voice or video telephony services;
- No Unreasonable Discrimination. Fixed broadband providers may not unreasonably discriminate in transmitting lawful network traffic; and
- Reasonable Network Management. Reasonable practices employed by broadband Internet access service providers that are consistent with open Internet protections.

However, critics warn the FCC's new rules could include introduction of usage-based pricing for accessing the Internet at home and preferential treatment for companies that pay extra for faster access to the network. Another potential short coming of the rules as identified by critics is that service providers may choose which websites can run faster than others over their respective networks. Still critics warn that the FCC's actions are an inappropriate over-reach of a Federal agency.

THE FCC'S NET NEUTRALITY RULES

The FCC's rules come after its issuance of its "Connecting America: The National Broadband Plan," as mandated by the American Recovery and Reinvestment Act of 2009 (See ETR Bulletin Article entitled, "FCC Broadband Plan," June 2010, Volume 7, Issue 1). The FCC has largely restricted the application of its rules to fixed, or wired, broadband access services while only requiring mobile broadband providers to comply with the transparency rule. The FCC's rationale, in part, is based on its assertion that mobile broadband is at an earlier stage in its development than fixed broadband. However, the FCC's rules prohibit mobile broadband providers from blocking lawful websites and applications that compete with their voice and video telephony services.

Transparency

A key purpose of the FCC's transparency rule is to enable third-party experts (e.g., independent engineers and consumer watchdogs) to monitor and evaluate network management practices, in order to surface concerns regarding potential open Internet violations. The rule itself reads:

"A person engaged in the provision of broadband Internet access service shall publicly disclose accurate information regarding the network management practices, performance, and commercial terms of its broadband Internet access services sufficient for consumers to make informed choices regarding use of such services and for content, application, service, and device providers to develop, market, and maintain Internet offerings."[1]

The FCC's reasoning for the transparency rule is based on five tenets. First, the FCC believes disclosure will ensure end users can make informed choices regarding the purchase and use of broadband service. Second, as end users' confidence in broadband providers' practices increases, their adoption of broadband services will increase as well. Third, disclosure supports innovation, investment, and competition by ensuring that startups and other edge providers have the technical information necessary to create and maintain online content, applications, services, and devices, and to assess the risks and benefits of embarking on new projects. Fourth, disclosure increases the likelihood that broadband providers will abide by open Internet principles, and that the Internet community will identify problematic conduct and suggest fixes. Fifth, disclosure will enable the FCC to collect information necessary to assess, report on, and enforce the other open Internet rules.

No Blocking

The purpose behind the FCC's no blocking rule is to ensure the freedom of consumers to send and receive lawful content. In addition, it is intended for users and providers to use and provide applications and other services without fear of blocking that may otherwise inhibit the Internet's openness and competition in adjacent markets such as

[1] FCC Report and Order (FCC 10-201), In the Matter of Preserving the Open Internet, Broadband Industry Practices, para. 54, adopted December 21, 2010.

voice communications and video and audio programming. The rule itself reads:

"A person engaged in the provision of fixed broadband Internet access service, insofar as such person is so engaged, shall not block lawful content, applications, services, or non- harmful devices, subject to reasonable network management."[2]

In short, the no-blocking rule prohibits broadband service providers from impairing or degrading particular content, applications, services, or non-harmful devices so as to render them effectively unusable (subject to reasonable network management).

No Unreasonable Discrimination

In the course of conducting the rulemaking, the FCC found that fixed broadband service providers have incentives as well as the ability to discriminate in their handling of network traffic in ways that can harm innovation, investment, competition, end users, and free expression. The FCC's rule attempts to strike a balance between restricting harmful conduct and permitting beneficial forms of differential treatment. The rule itself reads:

"A person engaged in the provision of fixed broadband Internet access service, insofar as such person is so engaged, shall not unreasonably discriminate in transmitting lawful network traffic over a consumer's broadband Internet access service. Reasonable network management shall not constitute unreasonable discrimination."[3]

The FCC's primary purpose behind its "no unreasonable discrimination" rule can be summed up by its concern over the following three practices. First, the FCC prohibits discrimination that harms an actual or potential competitor to the broadband provider (such as by degrading certain Voice over Internet Protocol (VoIP) applications or services when the broadband provider offers telephone service). Second, prohibit practices that harm end users (such as by inhibiting end users from accessing the content, applications, services, or devices of their choice). Third, prohibit practices that impair free expression (such as slowing traffic from a particular blog because the broadband provider disagrees with the content of blogger's message).

However, the FCC's rule does not prohibit tiered or usage-based pricing. The rules adopted by the FCC do not prevent broadband providers from asking subscribers who use the network more to pay more, and subscribers who use the network less to pay less.

Reasonable Network Management

The FCC's three above rules are all subject to a fourth, underlying belief that broadband service providers should be allowed to institute reasonable network management protocols and practices. Legitimate network management purposes identified by the FCC are: ensuring network security and integrity, including by addressing traffic that is harmful to the network; addressing traffic unwanted by end users (including by premise operators), such as by providing services or capabilities consistent with an end user's choices regarding parental controls or security capabilities; and reducing or mitigating the effects of congestion on the network. The rule itself reads:

"A network management practice is reasonable if it is appropriate and tailored to achieving a legitimate network management purpose, taking into account the particular network architecture and technology of the broadband Internet access service."[4]

The FCC acknowledged that reasonable network management practices may differ across service platforms. For example, practices to manage congestion on a fixed satellite network may be inappropriate for a fiber-to-the-home network. The FCC also recognized the unique network management challenges facing broadband providers that use unlicensed spectrum to deliver service to end-users (i.e., unlicensed spectrum is shared among multiple users and technologies and no single user can control or assure access to the spectrum).

CONCLUSION

The FCC's Net Neutrality rules have sparked a large amount of controversy since they were issued in December 2010. Diverse interpretations of the rules characterize them as either having gone too far in a heavy-handed attempt to regulate the Internet or not having gone far enough in protecting consumers' interests. The only thing on which critics agree is that the rules are vague and subject to interpretation and will likely lead to lawsuits as the FCC implements them.

"Intelligence provides the information we need, but technology further enables us to find the patterns and connections in that intelligence."

~ FBI Director Robert S. Mueller, III

[2] Ibid, para. 63.
[3] Ibid, para. 68.
[4] Ibid, para. 83.

3. WIRELESS EVOLUTION

INTRODUCTION

The vision of a robust mobile broadband capability has become a reality with millions of people actively using smartphones, tablets, netbooks, Personal Digital Assistants (PDAs) and laptops with wireless Third Generation (3G)/Fourth Generation (4G) access. But this is only the beginning of what is to come. This will be the decade of the "anywhere/anytime" social existence with mobile broadband being integrated into every aspect of life. Recent major developments include: 3G near ubiquity, expanded smartphone capabilities, the availability of hundreds of thousands of mobile user applications, the introduction of new form factors (e.g. tablets), projections of mobile data, bandwidth demand that exceeds current capacity, and industry and government acknowledgement of the need for more spectrum. Other developments include: implementation of data offload via Wi-Fi and Femtocells, dramatic performance increases through High Speed Packet Access (HSPA) enhancements, initial deployments of Long Term Evolution (LTE) technology, and significant progress on specifications that will meet "true" 4G requirements. A lot is happening in the wireless sector.

3G technology has demonstrated the power and potential of always-on, anywhere network connectivity and has created a wave of industry innovation that spans devices, applications, Internet integration, and new business service delivery models. Currently used by hundreds of millions of people, mobile broadband connectivity is on the verge of becoming ubiquitous. It is doing so on a powerful foundation of networking technologies including Global System for Mobile Communications (GSM) with Enhanced Data Rates for GSM Evolution (EDGE), HSPA, and LTE. LTE, in a forthcoming release called LTE-Advanced, will be one of the first technologies to meet the new requirements of International Mobile Telecommunications Advanced (IMT-Advanced), an International Telecommunications Union (ITU) project, and realize a true 4G technology.

Through continuous innovation, Universal Mobile Telecommunications System (UMTS) with HSPA technology has established itself as a global, mobile-broadband solution. Building on the phenomenal success of GSM, the GSM-HSPA ecosystem has become the most successful communications technology family ever. Through a process of constant improvement, the GSM family of technologies has not only matched or exceeded the capabilities of competing approaches, but has significantly extended the life of each of its member technologies.

HSPA is strongly positioned to be the dominant mobile-data technology for the next five to ten years. To help leverage service provider investments in HSPA, the Third Generation Partnership Project (3GPP) standards body has developed a series of enhancements to create "HSPA Evolution", commonly referred to as "HSPA+". HSPA+ represents a rational development of the Wideband Code Division Multiple Access (WCDMA) approach, and it is the pathway to a totally new 3GPP radio platform called 3GPP LTE. LTE, which uses Orthogonal Frequency Division Multiple Access[1] (OFDMA), was initially deployed in 2010. At the same time, 3GPP recognizes the significant worldwide investments in GSM networks, and has defined enhancements to drastically increase EDGE data capabilities through an effort called Evolved EDGE.

Combining these advances in radio-access technology, 3GPP has spearheaded the development of major core-network architectural enhancements (e.g., the IP Multimedia Subsystem (IMS)) [See IMS Mini Tutorial] and the Evolved Packet Core[2] (EPC), formerly called System Architecture Evolution (SAE). These developments will make possible new types of services, effective integration of legacy and new networks, the convergence of fixed and wireless systems, and the transition from circuit-switched architectures for voice traffic to a fully packet-switched delivery solution. The result is a balanced portfolio of complementary technologies that includes both radio access and core networks, provides service providers maximum freedom in how they enhance their networks over time, and delivers unified voice and data services.

This white paper focuses on the evolution of EDGE, HSPA enhancements, 3GPP LTE, the capabilities of these technologies, and their position relative to other primary competing technologies. It explains how these technologies fit into the ITU roadmap that leads to IMT-Advanced and the migration from 3G to 4G. The following are some important observations. (Subsequent ETR Bulletins will look at these technologies and new applications supported as they are rolled out onto the network.)

- The wireless technology roadmap now extends to IMT-Advanced with LTE-Advanced being one of the first technologies specified to meet the IMT-Advanced

[1] Orthogonal Frequency-Division Multiple Access is a multi-user version of the popular Orthogonal frequency-division multiplexing (OFDM) digital modulation scheme. Multiple access is achieved in OFDMA by assigning subsets of subcarriers to individual users. This allows simultaneous low data rate transmission from several users.

[2] The main component of the System Architecture Evolution (SAE) architecture is the Evolved Packet Core (EPC), also known as SAE Core. The EPC will serve as equivalent of GPRS networks (via the Mobility Management Entity, Serving Gateway and PDN Gateway subcomponents).

requirements. LTE-Advanced will be capable of peak throughput rates that exceed 1 Gigabit per second (Gbps).

- Future networks will be networks of networks consisting of multiple-access technologies, multiple bands, widely varying coverage areas, all self-organized and self-optimized, and based on an IMS approach.
- GSM-HSPA has a significant global lead in terms of subscribers, deployment, and services. It will continue to dominate other wide-area wireless technologies.

In current deployments, HSPA users regularly experience throughput rates far in excess of 1 Megabit per second (Mbps), generally under favorable conditions, on both downlinks and uplinks, with 4 Mbps downlink speed commonly being observed. Planned enhancements such as dual-carrier operation[3] will double user achievable peak throughput rates.

- HSPA+ provides a strategic performance roadmap advantage for incumbent GSM HSPA service providers. Features such as multi-carrier operation, Multiple Input/ Multiple Output (MIMO)[4], and higher-order modulation offer service providers several options for upgrading their networks, with many of these features (e.g., multi-carrier, higher order modulation) being available as network software upgrades. With all planned features implemented, HSPA+ peak rates will eventually reach 168 Mbps.
- HSPA+ with 2x2 MIMO, successive interference cancellation,[5] and 64 Quadrature Amplitude Modulation[6] (QAM) is more spectrally efficient than competing technologies including Worldwide Interoperability for Microwave Access (WiMAX) Release 1.0.
- The 3GPP OFDMA technology used in LTE matches or exceeds the capability of any other OFDMA systems. Peak theoretical downlink rates are 326 Mbps in a 20 Megahertz (MHz) channel bandwidth. LTE assumes a full Internet Protocol (IP) network architecture, and it is designed to support voice in the packet domain.
- LTE has become the technology platform of choice as GSM-UMTS and Code Division Multiple Access (CDMA)/ One Carrier Evolved, Data Optimized (EV-DO) service providers are making strategic, long-term decisions to deploy their next generation platforms.
- GSM-HSPA[7] will comprise the large majority of subscribers over the next five to ten years, even as new wireless technologies are developed. The deployment of LTE and its coexistence with UMTS-HSPA will be similar to the deployment of UMTS HSPA and its coexistence with GSM.
- 3GPP has made considerable progress on how to enhance LTE to meet the requirements of IMT-Advanced in an activity referred to as LTE-Advanced. LTE-Advanced is expected to be the first true 4G system available. Specifications are to be completed by March of 2011, and the earliest deployment may be in 2012.
- HSPA-LTE has significant economic advantages over other wireless technologies.
- WiMAX has developed network specifications supported by many providers, but it will likely represent only a very small percentage of wireless subscribers over the next five years.
- EDGE technology has proven highly successful and is broadly deployed on GSM networks globally. Advanced capabilities with Evolved EDGE can double and ultimately quadruple current EDGE throughput rates, halve latency, and increase frequency spectral efficiency.
- EPC will provide a new core network that supports both LTE and interoperability with legacy GSM-UMTS radio-access networks and non-3GPP based radio access networks. Policy based billing and control provides flexible quality-of-service (QoS) management, enabling new types of applications, as well as billing measures.
- Innovations such as EPC and UMTS one-tunnel architecture[8] will "flatten" the network, simplify deployment, and reduce latency. This is a significant benefit for service providers that will impact lawful surveillance methods.

[3] A mobile device in a dual-carrier communication system communicates with a network via first and second carriers by receiving data in the first cell via one of the first and second carriers on one carrier frequency, whilst receiving system information and/or downlink data from a second cell via the other of the first and second carriers on another carrier frequency.

[4] **MIMO** is the use of multiple antennas at both the transmitter and receiver to improve communication performance.

[5] Users are ordered by their chance of successful decoding and the packet of the strongest user is decoded first. After a packet is decoded, the signal is reconstructed and subtracted from the received signal. The rest of the users are ordered again for the next round of decoding. The procedure is performed iteratively over all users.

[6] **QAM** is both an analog and a digital modulation scheme. It conveys two analog message signals, or two digital bit streams, by changing (modulating) the amplitudes of two carrier waves, using the amplitude-shift keying (ASK) digital modulation scheme or amplitude modulation (AM) analog modulation scheme.

[7] This paper's use of the term "GSM-HSPA" includes GSM, EDGE, UMTS, HSPA and HSPA+. "UMTS-HSPA" refers to UMTS technology deployed in conjunction with HSPA capability.

[8] **Flat architecture:** The direct tunnel approach facilitates the handling of user plane throughput in the core network. User plane processing requires a lot of processing capacity in the SGSN, but the solution enables the operator to transfer user plane traffic beyond the SGSN using the IP backbone. Creating the user plane tunnel directly between the RAN and the GGSN optimizes the operator's costs, since most of the throughput capacity can be carried by standard IP routers and switches. This simplifies user plane dimensioning and operators no longer need to over-dimension SGSNs to carry user plane data safely.

Transition to 4G

There is some misunderstanding in the industry as to what technology falls into which cellular generation. Generally speaking, 1G refers to analog cellular technologies; it was first available in the 1980s. 2G denotes initial digital systems, introducing services such as short messaging and lower (limited) speed data.[9] CDMA2000 1xRTT and GSM are the primary 2G technologies, although CDMA2000 1xRTT is sometimes called a 3G technology because it meets the 144 Kilobits (kbps) mobile throughput requirement for 3G. EDGE also meets this requirement. 2G technologies became available in the 1990s.

3G requirements were specified by the ITU as part of the International Mobile Telephone 2000 (IMT-2000) project, for which digital networks had to provide 144 Kbps of throughput at mobile speeds, 384 Kbps at pedestrian (walking) speeds, and 2 Mbps while stationary. UMTS-HSPA and CDMA2000 EV-DO are the primary 3G technologies, although WiMAX was recently also designated as an official 3G technology. 3G technologies began deployment in the last decade (2000s).

The ITU recently issued requirements for IMT-Advanced. They constitute the only official definition of 4G. The requirements include operation in up to 40 MHz radio channels with extremely high spectral efficiency. However, the ITU recommends operation in up to 100 MHz radio channels and peak spectral efficiency of 15 bps/Hz, resulting in a theoretical throughput rate of 1.5 Gbps. Previous to the publication of these requirements, 1 Gbps was frequently cited as the 4G goal.

No available technology meets these requirements, today. It will require new technologies such as LTE-Advanced (with work already underway) and IEEE 802.16m. For marketing purposes, some have tried to label current versions of WiMAX and LTE as "4G", but this is only accurate to the extent that such designation refers to the general approach or platform that will be enhanced to meet the 4G ITU requirements.

With WiMAX and HSPA significantly outperforming current 3G requirements, calling these technologies 3G clearly does not give them full credit, as they are a generation beyond existing technologies. But calling them 4G is not exactly correct either. Unfortunately, the generational labels do not properly capture the scope of available technologies and have resulted in some amount of market confusion. The following table highlights the generational characteristics.

Table 3-1 1G to 4G

Generation	Requirements	Comments
1G	No official requirements. Analog technology.	Deployed in the 1980s.
2G	No official requirements.	Digital Technology. First digital systems. Deployed in the 1990s. New services such as Short Message Service (SMS) and low-rate data. Primary technologies include IS-95 CDMA and GSM.
3G	ITU's IMT-2000 required 144 kbps mobile, 384 kbps pedestrian, 2 Mbps indoors.	Primary technologies include CDMA2000 1X/ EVDO and UMTS-HSPA.[10] WiMAX now an official 3G technology.
4G	ITU's IMT-Advanced requirements include ability to operate in up to 40 MHz radio channels and with very high spectral efficiency.	No technology meets requirements today. IEEE 802.16m and LTE Advanced being designed to meet requirements.

While service providers are starting to deploy LTE networks today, it will be the middle of the next decade before a large percentage of subscribers will actually be using LTE (or LTE-Advanced). During this deployment period, most networks and devices will support the full scope of the 3GPP family of technologies (GSM EDGE, HSPA, and LTE). The history of wireless network deployment provides a useful perspective. GSM, which in 2009 was still growing its user base, was specified in 1990 with initial networks deployed in 1991. The UMTS Task Force established itself in 1995, Release 99 specifications were completed in 2000, and HSPA+ specifications were completed in 2007. Although it's been more than a decade since work began on the technology, only now is UMTS deployment and acceptance starting to take off. Figure 3-1 highlights the transition of wireless technology from early 2000.

[9] 2G: · digital systems · leverage technology to increase capacity – Speech compression; digital signal processing · utilize/extend "Intelligent Network" concepts · improve fraud prevention · add new services · whole range of standards · most successful GSM (TDMA based) · other US versions (CDMA based)

[10] High Speed Packet Access (HSPA): HSPA is the set of technologies that defines the migration path for 3G/WCDMA operators worldwide. It includes **High Speed Downlink Packet Access (HSDPA), High Speed Uplink Packet Access (HSUPA), and HSPA Evolved.** In most HSPA networks, the end-user can expect to enjoy speeds of at least 1Mbps upwards, depending on the peak speed of the network (anywhere from 1.8 Mbps to 14.4 Mbps) with peak uplink speeds of up to 5.7 Mbps. **HSPA Evolved** introduces Multiple-Input/Multiple-Output (MIMO) capabilities and higher order modulation (64 QAM), enabling greater throughput speeds and higher performance.

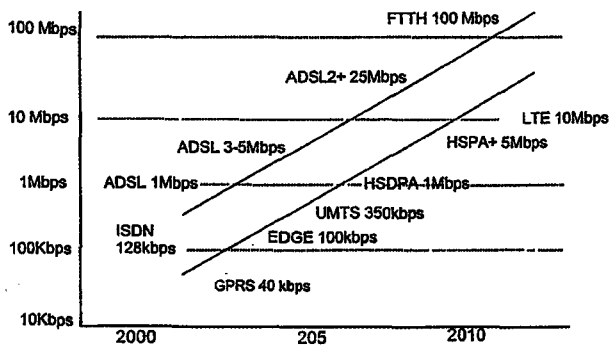


Figure 3-1 Wireless/Wireline Technology Transition (Illustrated)

Wireless versus Wireline Advances

Today, wireless technology assumes a dominant role in communications, even though wireline technology, with fiber links, has inherent capacity advantages. The overwhelming global success of mobile telephony, and the growing demand for mobile data, conclusively demonstrates the desire for mobile communications.

Mobile broadband combines robust high-speed data services with mobility and anytime, anywhere access. Thus, the opportunities are endless when viewing the many diverse markets mobile broadband can effectively address. Developed countries continue to show incredible demand for mobile broadband services. Additionally, in developing countries, there is no doubt that 3G technology will cater to both enterprises and their high end mobile workers and consumers, for whom 3G can be a cost effective solution, competing with digital subscriber line (DSL) or cable for at home access.

Relative to wireless networks, wireline networks have always had superior capacity, and historically have always delivered faster throughput rates. Wireless technologies have increased typical user throughput rates; however, wireline enjoys a consistent 10x advantage over wireless technologies. It is not throughput that makes wireless access attractive, it is mobility. Taking advantage of the strengths of each technology leads to the efforts to support seamless mobility (e.g., roaming through multiple networks).

Despite some of the inherent limitations of wireless technology relative to wireline, its fundamental appeal of providing access from anywhere has fueled its market growth. As the decade progresses, the lines between wireline and wireless networks will blur. The fact is that wireless networks are mostly wireline in their transport infrastructure. If an LTE picocell is serving a small number of houses using fiber backhaul, is this a wireline or wireless network? The answer is both.

Bandwidth Management Trends

Given enormous growth in usage, mobile service providers are either employing or considering multiple approaches to manage their limited bandwidth:

- **More spectrum.** Spectrum correlates directly to capacity, and more spectrum is becoming available globally for mobile broadband. Purchase of spectrum from the government, however, is expensive.
- **Increased spectral efficiency.** Newer technologies are spectrally more efficient, meaning greater throughput in the same amount of spectrum.
- **More cell sites.** Smaller cell sizes result in more capacity per subscriber, as fewer users are competing for the frequency spectrum.
- **Femtocells.**[11] Femtocells can significantly offload the macro network. Pricing plans can encourage users to move high-bandwidth activities (e.g., movie downloads and IPTV) to Femtocell connections.
- **Wi-Fi.** Wi-Fi networks offer another means of offloading intense radio access traffic.
- **Off-peak hours.** Service providers can offer lower rates or fewer restrictions on large data transfers that occur at off-peak hours such as overnight.
- **QoS.** By prioritizing traffic, large downloads can occur with lower priority, thus not affecting other active users. (See Article 2 on FCC's Net Neutrality Rules)
- **Innovative data plans.** Creative new data plans that influence consumption behavior, including tiered pricing, could make usage affordable for most subscribers, and could discourage excessive or abusive use.

It will take a creative blend of all of the above to make the mobile broadband market successful and to enable it to exist as a complementary solution to wired broadband.

EDGE/HSPA/HSPA+/LTE Deployment

Most GSM networks today support EDGE, which represents more than 478 networks in approximately 190 countries.[12] Meanwhile, UMTS has established itself globally. Nearly all WCDMA handsets are also GSM handsets, so WCDMA users can access the broad base of GSM networks and services.

[11] Femtocells are low-power wireless access points that operate in licensed spectrum to connect standard mobile devices to a mobile operator's network using residential DSL or cable broadband connections.

[12] GSA, June 2010

There are more than 500 million UMTS-HSPA customers worldwide spanning 347 commercial networks.[13] 324 service providers in 137 countries offer HSDPA and 100 of these have deployed HSUPA. Almost all UMTS operators are deploying HSPA for two reasons:

- The incremental cost of HSPA is relatively low, and
- HSPA makes such efficient use of spectrum for data that it results in a much lower overall cost per Megabyte (MB) of data delivered.

Demonstrating marketplace commitment to HSPA technology, at the close of 2010, there were more than 2,350 commercial HSPA devices available worldwide from 230 suppliers. Devices include handsets, data cards, modems, routers, laptops, media players, and cameras.

Service providers have begun deploying evolved HSPA features. As of June 2010, 65 HSPA+ networks are in service in 35 countries.[14] As the technology matures, upgrading to HSPA+ will likely represent a minimal investment for service providers in order to significantly boost their network performance.

LTE appears to be the preferred choice for service providers as their next-generation wireless technology. It has also been selected by public-safety organizations as their broadband technology of choice. The Association of Public-Safety Communications Officials[15] (APCO) and the National Emergency Number Association (NENA) have both endorsed LTE.[16]

Competitive Positioning of Wireless Technologies

Table 3-2 Competitive Position of Major Wireless Technologies

Technology	EDGE/HSPA/LTE	CDMA2000	WiMAX
Subscribers	Over 4.4 billion	518 million[17] today; slower growth expected than GSM-HSPA	61 million anticipated by 2014
Maturity	Extremely mature	Extremely mature	Emerging
Adoption	Cellular operators globally	Cellular operators globally	Limited to date
Coverage/Footprint	Global	Global with the general exception of Western Europe	Limited
Deployment	Fewer cell sites required at 700 and 850 MHz	Fewer cell sites required at 700 and 850 MHz	Many more cell sites required at 2.5
Devices	Broad selection of GSM/ EDGE/UMTS/ HSPA devices	Broad selection of 1xRTT/EV-DO devices	Initial devices emphasize data
Radio Technology	Highly optimized TDMA for EDGE, CDMA for HSPA, OFDMA for LTE	Highly optimized CDMA for Rev 0/A/B	Optimized OFDMA in Release 1.0. More optimized in Release 1.5
Spectral Efficiency	Very high with HSPA, matches OFDMA approaches in 5 MHz with HSPA+	Very high with EVDO Rev A/B	Very high, but not higher than HSPA+ for Release 1.0, and not higher than LTE for Release 1.5
Throughput Capabilities	Peak downlink user-achievable rates of over 4 Mbps today with achievable rates of over 8 Mbps today with HSPA+	Peak downlink user-achievable rates of over 1.5 Mbps, with significantly higher rates in the future	3 to 6 Mbps typical rates with bursts to 10 Mbps
Voice Capability	Extremely efficient circuit-voice available today; smoothest migration to VoIP of any technology	Extremely efficient circuit-voice available today EV-DO radio channels with VoIP cannot support circuit-voice users	Relatively inefficient VoIP initially; more efficient in later stages, but lower than LTE Voice coverage will be much more limited than cellular
Simultaneous Voice and Data	Available with GSM[18] and UMTS today	Not available today. Available with VoIP and future devices	Potentially available, though initial services will emphasize data
Efficient Spectrum Usage	Entire UMTS radio channel available for any mix of voice and high speed data	Radio channel today limited to either voice/ medium speed data or high speed data only	Currently only efficient for data centric networks

[13] Cisco, "Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update," February 10, 2010.
[14] 3G Americas, June, 2010.
[15] APCO International is the world's largest organization of public safety communications professionals. It serves the needs of public safety communications practitioners worldwide and the welfare of the general public as a whole by providing complete expertise, professional development, technical assistance, advocacy, and outreach.
[16] http://www.fiercewireless.com/story/public-safety-groups-endorse-lte-broadbandsolution/2009-06-12
[17] CDG, July 2010 for Q4 2009.
[18] Dual Transfer Mode (DTM) is a protocol based on the GSM standard that allows simultaneous transfer of Circuit switched (CS) voice and Packet switched (PS) data over the same radio channel (ARFCN). DTM is a 3GPP baseline R99 feature.

3GPP Evolutionary Approach

3GPP standards development falls into three principal areas: radio interfaces, core networks, and services. With respect to radio interfaces, rather than focusing on any one wireless approach, 3GPP's evolutionary plan recognizes the strengths and weaknesses of every technology and consequently exploits the unique capabilities of each one. Note that GSM, based on a Time Division Multiple Access[19] (TDMA) approach, is mature and broadly deployed.

Already extremely efficient, there are nevertheless opportunities for additional optimization and enhancements. Standards bodies have already defined "Evolved EDGE", which was available for deployment in the 2009 to 2010 timeframe. Evolved EDGE more than doubles throughput over current EDGE systems, reduces latency by half, and increases spectral efficiency. By the end of the decade, due to total market momentum, the majority of worldwide subscribers will still be using GSM/EDGE technologies.

Meanwhile, CDMA was selected as the basis of 3G technologies including WCDMA for the Frequency Division Duplex[20] (FDD) mode of UMTS and Time Division CDMA (TD-CDMA) for the Time Division Duplex (TDD) mode of UMTS. The evolved data systems for UMTS, such as HSPA and HSPA+, introduce enhancements and simplifications that help CDMA based systems equal the capabilities of competing systems, especially with 5 MHz spectrum allocations.

HSPA innovations such as dual-carrier[21] HSPA, synchronizes the operation of HSPA on two adjacent 5 MHz carriers for higher throughput rates. In combination with MIMO, dual-carrier HSPA will achieve peak network speeds of 84 Mbps, and quad-carrier HSPA will achieve peak rates of 168 Mbps. Given some of the advantages of an Orthogonal Frequency Division Multiplexing (OFDM) approach, 3GPP has specified OFDMA as the basis of its LTE effort. LTE incorporates best-of radio techniques to achieve performance levels beyond what would be practical with CDMA approaches, especially in larger channel bandwidths. Similar to the way that 3G coexists with 2G systems in integrated networks, LTE systems will coexist with both 3G systems and 2G systems. Multimode devices will function across LTE/3G or even LTE/3G/2G, depending on network circumstances. Beyond radio technology, EPC provides a new core architecture that enables both flatter architectures and integration of LTE with both legacy GSM HSPA networks, as well as other wireless technologies. The combination of EPC and LTE is referred to as the Evolved Packet System (EPS).

LTE is crucial to service providers since it provides the efficiencies and capabilities demanded by the rapidly growing mobile broadband market. The cost for service providers to deliver data (e.g., cost per MB) is almost directly proportional to the spectral efficiency of the technology. LTE has the highest spectral efficiency of any currently specified technology, making it an essential technology as market demand increases.

LTE supports both FDD and TDD modes. Many deployments will be based on FDD in paired spectrum. The TDD mode, however, will be important in enabling deployments where paired spectrum is unavailable. LTE TDD will be deployed in China; it will be available for Europe at 2.6 GHz, and available for the U.S. Broadband Radio Service (BRS) 2.6 GHz band. It is also being considered for the TDD portions of the U.S. Wireless Communications Service (WCS) band. Over the last year, LTE TDD has developed considerable market momentum, and is emerging as a competitive threat to other OFDMA TDD technologies.

ITU's IMT-Advanced

To address ITU's IMT-Advanced requirements, 3GPP is developing LTE-Advanced, a technology that will have peak rates of more than 1 Gbps.

Development of GSM and UMTS-HSPA happens in stages referred to as 3GPP releases. Equipment vendors' products support particular versions of each specification. It is important to realize that 3GPP releases address multiple technologies. For example, Release 7 optimizes Voice over Internet Protocol (VoIP) for HSPA, but also significantly enhances GSM data functionality with Evolved EDGE. A summary of the different 3GPP releases is as follows:[22]

- **Release 99:** Completed. First deployable version of UMTS. Enhancements to GSM data (EDGE). Majority of deployments today are based on Release 99. Provides support for GSM/EDGE/GPRS/WCDMA radio-access networks.
- **Release 4:** Completed. Multimedia messaging support. First steps toward using IP transport in the core network.
- **Release 5:** Completed. HSDPA. First phase of IMS. Full ability to use IP-based transport instead of just Asynchronous Transfer Mode (ATM) in the core network.
- **Release 6:** Completed. HSUPA. Enhanced multimedia

[19] TDMA is a channel access method for shared medium networks. It allows several users to share the same frequency channel by dividing the signal into different time slots.

[20] FDM is a form of signal multiplexing which involves assigning non-overlapping frequency ranges to different signals or to each "user" of a medium.

[21] The basic idea of the multicarrier feature is to achieve better resource utilization and spectrum efficiency by means of joint resource allocation and load balancing across the downlink carriers.

[22] After Release 99, release versions went to a numerical designation instead of designation by year.

support through Multimedia Broadcast/Multicast Services (MBMS). Performance specifications for advanced receivers. Wireless Local Area Network (WLAN) integration option. IMS enhancements. Initial VoIP capability.

- **Release 7:** Completed. Provides enhanced GSM data functionality with Evolved EDGE. Specifies HSPA+, which includes higher order modulation and MIMO. Performance enhancements, improved spectral efficiency, increased capacity, and better resistance to interference. Continuous Packet Connectivity (CPC) enables efficient "always-on" service and enhanced uplink UL VoIP capacity, as well as reductions in call set-up delay for Push-to-Talk Over Cellular (PoC). Radio enhancements to HSPA include 64 QAM in the downlink DL and 16 QAM in the uplink. Also includes optimization of MBMS capabilities through the Multicast/Broadcast, Single-Frequency Network (MBSFN) function.
- **Release 8:** Completed. Includes further HSPA Evolution features such as simultaneous use of MIMO and 64 QAM. Includes dual-carrier HSPA (DC-HSPA) wherein two WCDMA radio channels can be combined for a doubling of throughput performance. Specifies OFDMA-based 3GPP LTE. Defines EPC.
- **Release 9:** Completed. HSPA and LTE enhancements including HSPA dual-carrier operation in combination with MIMO, EPC enhancements, Femtocell support, support for regulatory features such as emergency user equipment positioning and the Commercial Mobile Alert System (CMAS), and evolution of IMS architecture.
- **Release 10:** Under development. Expected to be complete in 2011. Will specify LTE-Advanced that meets the requirements set by ITU's IMT-Advanced project. Also includes quad-carrier operation for HSPA+.

Spectrum

Another important characteristic of UMTS-HSPA deployment is the expanding number of available radio bands and the subsequent support from infrastructure and mobile equipment vendors. The fundamental system design and networking protocols remain the same for each band; however the frequency dependent portions of the radios have to change.

As new frequency bands become available for deployment, standards bodies are adapting UMTS for these bands. This includes 450 and 700 MHz. The 1710-1770 MHz uplink was matched with the 2110-2170 MHz downlink to allow for additional global harmonization of the 1.7/2.1GHz band. These new spectrum bands, allocated harmoniously across North, Central, and South America, are critical to efficiently meeting the growing needs of customers for mobile broadband applications.

The Federal Communications Commission (FCC) auctioned the 700 MHz band[23] in the United States in January 2008. The availability of this band, the Advanced Wireless Services (AWS) band at 1710-1755 MHz with 2110-2155 MHz in the U.S., and the forthcoming 2.6 GHz frequency band in Europe are providing service providers with wider deployment options. A growing number of providers are also deploying UMTS at 900 MHz, a traditional GSM band.

The spectrum projection does not take into account that small (short) message traffic (e.g., e-mail queries and SMS) consumes a disproportionate amount of capacity, nor that providers need additional radio channels for infill coverage or to separate[24] voice and data traffic on different channels.

Spectrum needs vary by service provider. Some may experience shortages well before others depending on multiple factors such as the amount of spectrum they have, cell site density relative to user demographics, type of devices they service, and their customer service plans. As the amount of available spectrum increases and as technologies simultaneously become spectrally more efficient, total capacity rises rapidly, supporting more subscribers and making many new types of applications feasible.

Different countries have regulated spectrum more loosely than others. For example, service providers in the United States can use either 2G or 3G technologies in cellular, Personal Communications Service (PCS), or 3G bands, whereas in Europe there are greater restrictions, although efforts are under way that will result in greater flexibility including the use of 3G technologies in current 2G bands.

With the projected increase in the use of mobile-broadband technologies, the amount of spectrum required by the next generation of wireless technology could be substantial. In the U.S., the FCC has committed itself to finding an additional 500 MHz of spectrum over the next 10 years as part of its National Broadband Plan. This would effectively double the amount of spectrum for commercial mobile radio service. As regulators make more spectrum available, it is important that such spectrum be:

[23] Analog TV spectrum
[24] Eliminate inter-band interference

1. Coordinated on a regional or global basis.
2. Unfettered by spectrum caps and other legacy voice-centric spectrum policies.
3. Made available in the widest radio channels possible (e.g., 10 MHz, 20 MHz, and more).
4. Utilized efficiently without causing interference to existing spectrum owners.

Emerging technologies such as LTE benefit from wider radio channels. These wider radio channels are not only spectrally more efficient; they offer greater capacity, which is an important attribute because typical broadband usage contributes to a much higher load than voice applications. Note that watching a YouTube™ video consumes 100 times as many bits per second on the downlink as a voice call.

Of some worry in this regard is that spectrum for LTE is becoming available in different frequency bands in different countries. Initial U.S. deployments will be at 700 MHz, in Japan at 1500 MHz, and in Europe at 2.6 GHz. With so many varying spectrum bands, roaming operations based on GSM or HSPA on common regional or global bands will likely be required.

Core-Network Evolution

3GPP is defining a progression of enhancements to the core network to improve network performance and the range of services provided. Improvements will enable a shift to all IP architectures. One way to improve core network performance is by using flatter architectures. The more hierarchical a network, the more effortlessly it can be managed centrally. The tradeoff, however, is reduced performance, especially for data communications, because packets must pass through and be processed by multiple nodes in the network. To enhance data performance and, in particular, to reduce latency (packet delays), 3GPP has defined a number of enhancements in Release 7 and Release 8 that decrease the number of processing nodes and result in a flatter architecture.

Release 7 introduces an option called one-tunnel architecture that allows service providers to configure their networks to allow user data to bypass a serving node and travel directly via a gateway node. There is also an option to integrate the functionality of the Radio Network Controller[25] (RNC) directly into the base station.

For Release 8, 3GPP defined an entirely new core network called the EPC. The key features and capabilities of EPC include:

- Reduced latency and higher data performance through a flatter architecture
- Support for both LTE radio access networks and interworking with GSM-HSPA radio access networks
- The ability to integrate non-3GPP networks such as WiMAX
- Optimization for all services provided via IP
- Comprehensive, network-controlled, QoS architecture

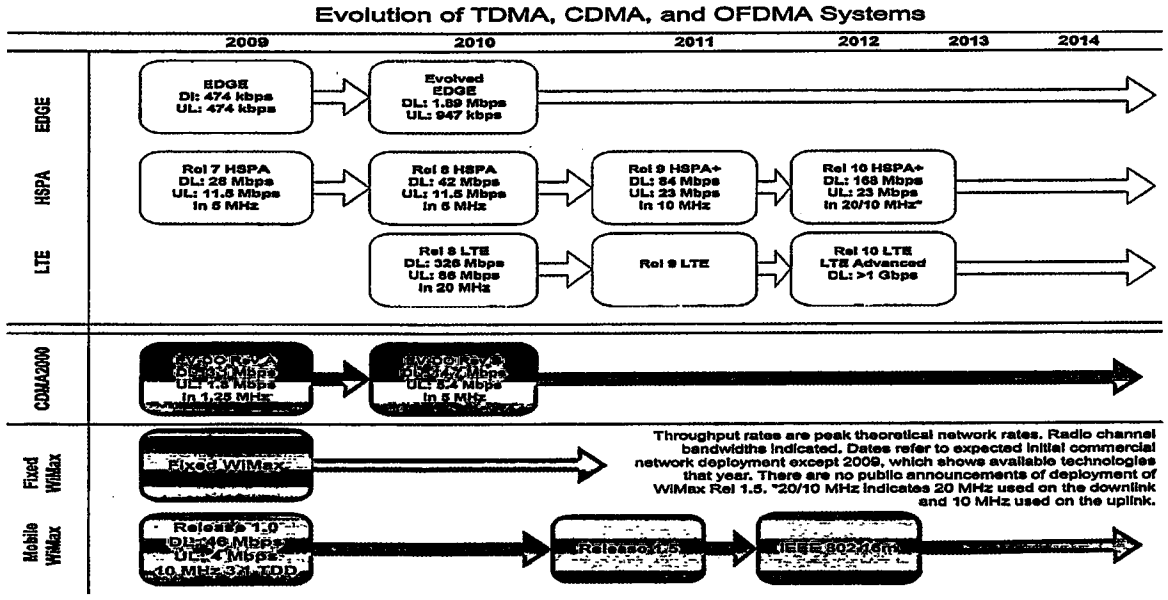


Figure 3-2 Evolution of TDMA, CDMA, and OFDMA Systems

[25] RNC is a governing element in the UMTS radio access network (UTRAN) and is responsible for controlling the Node Bs that are connected to it. The RNC carries out radio resource management, some of the mobility management functions and is the point where encryption is done before user data is sent to and from the mobile device.

Service Evolution

Not only do 3GPP technologies provide continual improvements in capacity and data performance, they also develop capabilities that expand the services available to subscribers. Important service advances include Fixed Mobile Convergence (FMC), IMS, and broadcasting technologies.

FMC refers to the integration of fixed services (such as telephony provided by wireline or Wi-Fi) with mobile cellular based services. Although FMC is still in its beginning stages of deployment, it promises to provide significant benefits to both users and service providers. For users, FMC will simplify how they communicate, making it possible for them to use a single device (e.g., a smart cell phone) at work, on the go or at home where it might connect via a Wi-Fi network or a Femtocell as well as the macro-radio network.

Users will also benefit from single voice mailboxes and single phone numbers, as well as the ability to be in command of how and with whom they communicate. For service providers, FMC allows the consolidation of core services across multiple access networks. For instance, a service provider could offer complete VoIP based voice service that supports access via DSL, cable, Wi-Fi, or 3G. FMC also offloads data intensive applications such as movie or video downloads from the macro network.

There are various approaches for FMC including Generic Access Network (GAN), previously called Unlicensed Mobile Access (UMA), femtocells, and IMS. With GAN, GSM-HSPA devices can connect via Wi-Fi or cellular connections for both voice and data. UMA/GAN is a 3GPP technology, and it has been deployed by a number of service providers including T-Mobile in the United States. A substitute for using Wi-Fi for the "fixed" portion of FMC is femtocells These are small base stations that cost little more than a Wi-Fi access point, and, like Wi-Fi, femtocells leverage a subscriber's existing wireline broadband connection (e.g., cable or DSL). Instead of operating on unlicensed bands, femtocells use the service provider's licensed bands at very low power levels. The significant advantage of the femtocells approach is that single mode, mobile communication devices can now operate using the femtocell.

IMS is another key technology for convergence. It supports access to core services and applications via multiple access networks. IMS is more powerful than GAN, because it supports not only FMC, but also a much broader range of potential applications. In the United States, AT&T has committed to an IMS approach and has already deployed an IMS-based video sharing service. Although defined by 3GPP, the Third Generation Partnership Project 2 (3GPP2), CableLabs, and WiMAX have adopted IMS. IMS is how VoIP will (or could) be deployed in CDMA 2000 EV-DO, WiMAX, HSPA, and LTE networks.

IMS allows innovative amalgamation of different types of communications and information including voice, video, Instant Messaging (IM), presence information, location, multi-media messaging, and documents. It provides application developers the platform to create applications that have never before been possible. It allows people to communicate in entirely new ways by dynamically using multiple services, with the ability to move from one application to another depending on the communication needs, all in real-time. For example, during an interactive chat session, a user could launch a voice call, and then include another person in that call or chat. Or during a voice call, a user could suddenly establish a simultaneous video connection or start transferring files while still communicating via a voice connection. While browsing the Web, a user could decide to speak to a customer service representative and transfer data to assist in the communications. IMS will be a key platform for all IP architectures for both HSPA and LTE.

A new initiative called Rich Communications Suite (RCS), supported by many service providers and vendors, builds upon the IMS technology. It provides a consistent feature set, as well as implementation guidelines, use cases, and reference implementations. RCS uses existing standards and specifications from 3GPP, OMA, and GSMA.

Core RCS features include:

- An enhanced phone book (device and/or network based) that includes service capabilities and presence enhanced contact information
- Enhanced messaging (supporting text, instant messaging, and multimedia) with chat and messaging history
- Enriched calls that include multimedia content (e.g., video sharing) during voice calls

Another important new service is support for mobile TV through what is called multicast or broadcast functions. 3GPP has defined multicast/broadcast capabilities for both HSPA and LTE.

Voice Support

While 2G and 3G technologies were deployed from the beginning with voice and data capability, LTE networks can be deployed with or without voice support. Moreover, there are a number of methods available for voice support including fallback to 2G/3G and VoIP operation. (See Long Term Evolution Article)

Device Innovation

Computing is becoming more mobile, and notebook computers and smartphones are now prevalent. In fact, all mobile phones are becoming "smart", with some form of data capability. Also, leading notebook vendors are now offering computers with integrated 3G (e.g., HSPA) capabilities. Modems are available in multiple formats including USB devices, Personal Computer (PC) cards, and Express cards.

Smartphones are becoming extremely powerful mini computers with general purpose operating systems and sophisticated application development environments. Smartphones, originally targeted for the high-end of the market, are now available at much lower price points and thus, are affordable to a much larger market segment. In the U.S., smartphones already account for some 25% of phones today, and they are on track to reach 50% by 2011.[26] The continued success of the BlackBerry along with the success of the iPhone and Android devices demonstrates the potential of this market. From a radio perspective, today's phones can support ever more bands and technologies. This makes phones that work across the world feasible. Increasingly, users expect their phones to work anywhere they go.

Computer manufacturers are also delivering new form factors such as netbooks, tablet computers, mobile Internet devices (MID), and smartbooks. The movement to open networks allows a greater number of companies to develop products that use wireless networks in both vertical-market and horizontal-market scenarios. Cellular telephones are becoming more powerful and feature large color touch displays, graphics and video viewers, still cameras, movie cameras, music players, IM clients, email clients, PoC, downloadable and executable content capabilities, and more powerful browsers. All of these capabilities consume data.

Network Interfaces for Applications

Another important development related to service evolution is service providers making interfaces available to external applications for information and control. Today, two widely deployed capabilities include location queries and SMS.

With location services, mobile devices or external applications (e.g., applications operating on computers outside of the network) can query the location of a user, subject to privacy restrictions. This can significantly enhance many applications including navigation, supplying location of nearby destinations (e.g., restaurants and stores), location of friends for social networking, and worker dispatch. With SMS, external applications can send user requested content such as flight updates.

Table 3-3 Parlay X Specifications

Part	Title	Functions
1	Common	Definitions common across Parlay X specifications
2	Third Party Call	Creates and manages calls
3	Call Notification	Management of calls initiated by a subscriber
4	Short Messaging	Send and receive of SMS including delivery receipts
5	Multimedia Messaging	Send and receive of multimedia messages
6	Payment	Pre-paid and post-paid payments and payment reservations
7	Account Management	Management of accounts of prepaid customers
8	Terminal Status	Obtain status such as reachable, unreachable, or busy
9	Terminal Location	Obtain location of terminal
10	Call Handling	Control by application for call handling of specific numbers
11	Audio Call	Control for media to be added/dropped during call
12	Multimedia Conference	Create multimedia conferences including dynamic management of participants
13	Address List Management	Manage subscriber groups
14	Presence	Provide presence information
15	Message Broadcast	Send messages to all users in specified area
16	Geocoding	Obtain location address of subscriber
17	Application-driven QoS	Control QoS of end-user connection
18	Devices Capabilities and Configuration	Obtain device capability information and be able to push device configuration to device
19	Multimedia Streaming Control	Control multimedia streaming to device
20	Multimedia Multicast Session Management	Control multicast sessions, members, multimedia stream, and obtain channel presence information

[26] Nielsen, "The Droid: Is this the Smartphone Consumers are Looking For?" November 11, 2009, http://blog.nielsen.com/nielsenwire/consumer/the-droid-is-this-the-smartphone-consumers-arelooking-for/.

Mobile Application Architectures

Many applications used over wireless connections will be the same as those used over the Internet with desktop/laptop PCs. An increasing number of applications, however, will be developed specifically for mobile devices. This can be a challenge for developers, because there are a number of different mobile platforms available including Android, Apple iPhone, LiMo, Palm Pre, RIM BlackBerry, Symbian, and Windows Mobile. Unlike the desktop market, the mobile device market has become fragmented. Each of the device platforms comes with its own application development environment, and developers must face a learning curve to become adept at programming for any specific platform. Some developers may be content targeting specific platforms. Others, however, may need their applications to operate across multiple platforms. Fortunately, there are various developments that address the fragmentation challenge. These include:

- **Mobile Middleware.** These are software infrastructures that consist of a client component that operates on the mobile device, and a server component that acts as a proxy for the client. Vendors provide tools with which developers can develop an application in a platform-neutral manner, which enables the application to operate on multiple device types. Mobile middleware is mostly used for business applications.
- **Mobile Web 2.0.** Mobile browsers are adopting many of the same sophisticated capabilities as desktop browsers. Combined with networks that have higher throughputs and lower latency[27], an increasing number of applications can be Web hosted, making the applications available from diverse platforms. Mobile Web 2.0 technologies include items such as Ajax, offline operation, video capabilities, fast JavaScript execution, and mash-ups (combining data from multiple Web sources). Cloud computing, enabled by Mobile Web 2.0, will play an important role for mobile systems and for desktops.
- **Push Architectures.** Many mobile applications are notification oriented, meaning users want to know when new information is available in applications like e-mail or social networking. "Pushing" small amounts of data on a regular basis to large numbers of users, or having devices poll on a regular basis, can impact network capacity. In response, 3GPP has specified supporting mechanisms such as Paging Channel (PCH) states and tools for enabling rapid transitions between active and inactive states.
- **Eventual Market Consolidation.** Though the market is currently fragmented, there are certain platforms (e.g., Android, BlackBerry, and iPhone) that represent a relatively dominant market share. Increasingly, developers are choosing to develop for just a small number of these platforms using the development tools specific to that environment.

Broadband-Wireless Deployment Considerations

Much of the debate in the wireless industry deals with the merits of different radio technologies. Yet, other factors are equally important in determining the services and capabilities of a wireless network. These factors include the amount of spectrum available, backhaul, and network topology.

Spectrum has always been a major consideration for deploying any wireless network, but it is particularly important when looking at high-performance broadband systems. HSPA and HSPA+ can deliver high throughput rates on the downlink and uplink with low latency in 5 MHz channels when deployed in single frequency (1/1) reuse. By this, we mean that every cell sector (typically three per cell) in every cell uses the same radio channel(s).

To achieve higher data rates requires wider radio channels, such as 10 or 20 MHz wide channels, in combination with emerging OFDMA radio technologies. Very few operators today, however, have access to this much spectrum. It was challenging enough for GSM operators to obtain UMTS spectrum. If delivering very high data rates are the objective, then the system must minimize interference. This result is best achieved by employing looser reuse, such as having every sector use only one-third of the available radio channels (1/3 reuse). The 10 MHz radio channel could now demand as much as 30 MHz of available spectrum.

Backhaul is another factor. As the throughput of the radio link increases, the circuits connecting the cell sites to the core network must be able to handle the increased load. With many cell sites today serviced by just a small number of T1/E1 circuits, each able to carry only 1.5/2.0 Mbps, operators are in the process of upgrading backhaul capacity to obtain the full benefit of next-generation wireless technologies. Approaches include emerging wireline technologies such as VDSL and optical Ethernet, as well as point-to point microwave systems. An OFDMA system with 1.5 bps per hertz (Hz) of spectral efficiency in 10 MHz on three sectors has up to 45 Mbps average cell throughput.

[27] Latency in a packet-switched network is measured either one-way (the time from the source sending a packet to the destination receiving it), or round-trip (the one-way latency from source to destination plus the one-way latency from the destination back to the source).

Additionally, any technology's ability to reach its peak spectrum efficiency is somewhat contingent on the system's ability to reach the instantaneous peak data rates allowed by that technology. For example, a system claiming spectrum efficiency of 1.5 bps/Hz (as described) might rely on the ability to reach 100 Mbps instantaneously to achieve this level of spectrum efficiency. Any constraint on the transport system below 100 Mbps will restrict the range of achievable throughput and, in turn, impact the spectral efficiency of the system.

Finally, the overall network topology also plays an important role, especially with respect to latency. Low latency is critical to achieving very high data rates, because of the way it affects Transmission Control Protocol (TCP)/IP traffic. How traffic routes through the core network—how many hops and nodes it must pass through—can influence the overall performance of the network. One way to increase performance is by using flatter architectures, meaning a less hierarchical network with more direct routing from mobile device to end system. The core EPC network for 3GPP LTE emphasizes a flatter architecture.

It can be misleading to say that one wireless technology outperforms another without a full understanding of how that technology will be deployed in a complete system that also takes spectrum into account.

Data Offload

As data traffic loads increase, operators are seeking to offload some of the data traffic to other networks, particularly Wi-Fi networks. In the future, once they are widely deployed, offload onto Femtocells will also play an important role. The IEEE 802.11 family of technologies has experienced rapid growth, mainly in private deployments. The latest 802.11 standard, 802.11n, offers users throughputs in excess of 100 Mbps and improved range through use of MIMO. 802.11e provides QoS enabling VoIP and multimedia, 802.11i enables robust security, and 802.11r provides fast roaming, which is necessary for voice handover across access points.

Leveraging this success, service providers—including cellular operators—are offering hotspot service in public areas such as airports, fast-food restaurants, and hotels. For the most part, hotspots are complementary with cellular-data networks, because the hotspot can provide broadband services in extremely dense user areas and the cellular network can provide broadband services across much larger areas.

Wi-Fi has huge inherent capacity for two reasons. First, a large amount of spectrum (approximately 500 MHz) is available across 2.4 and 5 GHz bands. Second, the spectrum is used in small coverage areas, resulting in high frequency reuse. The result is much higher bps rates per square meter of coverage than with WANs. Various organizations are looking at integrating WLAN service with GSM Communications GSM-HSPA data services. The GSM Association has developed recommendations for Subscriber Identity Module (SIM) based authentication of hotspots, and 3GPP has multiple initiatives that address WLAN integration into its networks, including 3GPP System to WLAN interworking, UMA, IMS, and EPC.

Integration can either be loose or tight. Loose integration means data traffic routes directly to the Internet and minimizes traversal of the service providers network. This is called local breakout. Tight integration means data traffic, or select portions, may traverse the service providers core network. This is beneficial in situations where the service providers offer value added services (e.g., internal portals) that can only be accessed from within the core.

Essential to successful data offload is providing a good subscriber experience. This mandates measures such as automatically provisioning subscriber devices with the necessary Wi-Fi configuration options and automatically authenticating subscribers on supported public Wi-Fi networks. Work in 3GPP Release 10 is defining some specific mechanisms for offloading traffic. One is called IP Flow and Seamless Offload (IFOM) used to carry select traffic over Wi-Fi instead of a Femto connection. Another is called Selected IP Traffic Offload (SIPTO) used to offload the mobile core network by separating traffic out early.

Feature and Network Roadmap

GSM service providers first enhanced their networks to support data capability through the addition of General Packet Radio Service (GPRS) infrastructure with the ability to use existing cell sites, transceivers, and interconnection facilities. Since installing GPRS, GSM service providers have largely upgraded data service to EDGE, and any new GSM network includes EDGE capability.

Service providers have deployed UMTS-HSPA worldwide. Although, UMTS involves a new radio access network, several factors facilitate deployment. First, most UMTS cell sites can be collocated in GSM cell sites enabled by multi-radio cabinets that can accommodate GSM/EDGE, as well as UMTS equipment. Second, much of the GSM/

GPRS core network can be used. This means that all core-network elements above the Serving GPRS Support Node (SGSN) and Mobile Switching Center (MSC)—the Gateway GPRS Support Node (GGSN), the Home Location Register (HLR), billing and subscriber administration systems, service platforms, and so forth—need, at most, a software upgrade to support 3G UMTS-HSPA.

And while early 3G deployment used separate 2G/3G SGSNs and MSCs, all-new MSC and/or SGSN products are capable of supporting both GSM and UMTS-HSPA radio access networks. Similarly, new HSPA equipment will be upgradeable to LTE through a software upgrade.

New features are being designed so that the same upgraded UMTS radio channel can support a mixture of terminals. In other words, a network supporting Release 5 features (e.g., HSDPA) can support Release 99, Release 5, and Release 6 terminals (e.g., HSUPA) operating in a Release 5 mode. This flexibility assures the maximum degree of forward and backward compatibility. Note that most UMTS terminals today support GSM, thus facilitating use across large coverage areas and multiple networks. Once deployed, operators can minimize the costs of managing GSM/EDGE and UMTS networks, because these networks share many of the same aspects including:

- Packet-data architecture
- Cell sites
- Antenna systems
- Backhaul circuits
- Subscriber account management
- Service platforms

Users largely don't even need to know what type of network they are connected to because their multimode GSM-HSPA (and eventually GSM-HSPA-LTE) devices can seamlessly hand off between networks.

The changes being planned for the core network are another aspect of evolution. Here, the intent is to reduce the number of nodes that packets must traverse. This will result in both reduced deployment costs and reduced latency. The key enabling technology is EPC, which is described in detail later in this paper.

The upgrade to LTE will be relatively straightforward, with new LTE infrastructure having the ability to reuse a significant amount of the UMTS-HSPA cell site and base station including using the same shelter, tower, antennas, power supply, and climate control.

Different vendors have different so-called "zero-footprint" solutions allowing service providers to use empty space to enable reuse of existing sites without the need for any new floor space. A service provider can add LTE capability simply by adding a LTE baseband card. New multi-standard radio units (HSPA and LTE), as well as LTE only baseband cards, are mechanically compatible with existing building practices, so that operators can use empty space in an old base station for LTE baseband cards, thus enabling reuse of existing sites without the need for any new construction.

Base station equipment is available for many bands including the 1.7/2.1 GHz AWS band and the recently auctioned 700 MHz bands in the U.S. In 2010, service providers and vendors began LTE deployment. On the device side, multimode chipsets will enable devices to easily operate across UMTS and LTE networks. For example, one chipset vendor announced a series of chips that support the following combination of technologies: UMTS, HSPA+, and LTE; EVDO Rev B; and UMTS, HSPA+, EV-DO Rev B and LTE.[28]

One important and interesting aspect of technology deployment is that an advanced technology such as LTE enables service providers to upgrade prior technologies, such as HSPA. Examples include:

- VoIP for HSPA: since LTE uses an IP core, once it is deployed, supporting voice on HSPA via VoIP will be a much simpler task as it can share the same core IP network as LTE
- Device processing power: supporting the high throughput rates with LTE (e.g., 50 Mbps or higher) will provide sufficient processing in the device to also support very high HSPA rates (e.g., 30 Mbps or higher)

> The GSM family of technologies, which are interchangeably called the 3GPP family of technologies, are all based on the evolution of standards developed for GSM, EDGE, UMTS-HSPA, HSPA+, LTE, and LTE-Advanced.
>
> ~ 4G Americas' Board of Governors

[28] http://www.qualcomm.com/press/releases/2008/080207_Qualcomm_to_Ship.html.

Table 3-4 Expected UMTS/LTE Feature and Capability Availability

Year	Features
2010	Evolved EDGE capabilities available to significantly increase EDGE throughput rates and announced deployments. HSPA+ peak speeds further increased to peak rates of 42 Mbps based on Release 8. LTE introduced for next-generation throughput performance using 2X2 MIMO. Advanced core architectures available through EPC, primarily for LTE, but also for HSPA+, providing benefits such as integration of multiple antennas.
2011	LTE enhancements such as 4X2 MIMO and 4X4 MIMO available. LTE-Advanced specifications completed. HSPA+ with MIMO and dual-carrier available.
2012 and later	LTE-Advanced potentially deployed in initial stages. HSPA+ with MIMO and quad-carrier available. Most new services implemented in the packet domain.

Over time, the separate GSM/EDGE Radio Access Network (GERAN), UTRAN, and core-infrastructure elements will undergo consolidation, thus lowering total network cost and improving integrated operation of the separate access networks. For actual users with multimode devices, the networks they access will be largely transparent. Today, nearly all UMTS phones and modems support GSM/EDGE.

Service providers will deploy LTE in various configurations. Some will offer only data service on LTE. Others will offer data service on LTE in combination with voice over 2G or 3G. Yet others will provide both voice and data service on LTE. Individual service provider configurations will also evolve over time.

Table 3-5 Throughput Performance of Different Wireless Technologies

	Peak Network Speed (Down)	Peak and/or Typical User Rate - Down	Peak Network Speed (UP-Link)	Peak and/or Typical User Rate (UP-Link)
EDGE (type 2 MS)	473.6 kbps		473.6 kbps	
EDGE (type 1 MS) (Practical Terminal)	236.8 kbps	200 kbps peak 70 to 135 kbps typical	236.8 kbps	200 kbps peak 70 to 135 kbps typical
Evolved EDGE (type 1 MS)[29]	1184 kbps[30]	1 Mbps peak 350 to 700 kbps typical expected (Dual-Carrier)	473.6 kbps[31]	400 kbps peak 150 to 300 kbps typical expected
Evolved EDGE (type 2 MS)[32]	1894.4[33] kbps		947.2 kbps[34]	
UMTS WCDMA Release 99	2.048 Mbps		768 kbps	
UMTS WCDMA Release 99 (Practical Terminal)	384 kbps	350 kbps peak 200 to 300 kbps typical	384 kbps	350 kbps peak 200 to 300 kbps typical
HSDPA Initial Devices (2006)	1.8 Mbps	> 1 Mbps peak	384 kbps	350 kbps peak
HSDPA	14.4 Mbps		384 kbps	

[29] A type 1 Evolved EDGE MS can receive on up to ten timeslots using two radio channels and can transmit on up to four timeslots in one radio channel using 32 QAM modulation (with turbo coding in the downlink).
[30] Type 1 mobile, 10 slots downlink (dual-carrier), DBS-12(118.4 kbps/slot).
[31] Type 1 mobile, 4 slots uplink, UBS-12 (118.4 kbps/slot).
[32] A type 2 Evolved EDGE MS can receive on up to 6 timeslots using two radio channels and can transmit on up to eight timeslots in one radio channel using 32 QAM modulation (with turbo coding in the downlink).
[33] Type 2 mobile, 16 slots downlink (dual-carrier) at DBS-12 (118.4 kbps/slot).
[34] Type 2 mobile, 8 slots uplink, UBS-12 (118.4 kbps/slot).

HSPA[35] Initial Implementation	7.2 Mbps	> 5 Mbps peak 700 kbps to 1.7 Mbps typical[36]	2 Mbps	> 1.5 Mbps peak 500 kbps to 1.2 Mbps typical
HSPA Current Implementation	7.2 Mbps		5.76 Mbps	
HSPA	14.4 Mbps		5.76 Mbps	
HSPA+ (DL 64 QAM, UL 16 QAM, 2 X 5 MHz)	21.6 Mbps	1.9 Mbps to 8.8 Mbps[37] 13 Mbps peak[38]	11.5 Mbps	1 Mbps to 4 Mbps
HSPA+ (2X2 MIMO, DL 16 QAM, UL 16 QAM, 2 X 5 MHz)	28 Mbps		11.5 Mbps	
HSPA+ (2X2 MIMO, DL 64 QAM, UL 16 QAM, 2 X 5 MHz)	42 Mbps		11.5 Mbps	
HSPA+ (2X2 MIMO, DL 64 QAM, UL 16 QAM, Dual-Carrier, 2 X 10 MHz)	84 Mbps		23 Mbps	
HSPA+ (2X2 MIMO, DL 64 QAM, UL 16 QAM, Quad Carrier, 2 X 20 MHz)	168 Mbps		23 Mbps	
LTE (2X2 MIMO, 2 X 10 MHz)	70 Mbps	5.9 to 21.5 Mbps[39]	35 Mbps	
LTE (4X4 MIMO, 2 X 20 MHz)	326 Mbps		86 Mbps	
CDMA2000 1XRTT	153 kbps	130 kbps peak	153 kbps	130 kbps peak
CDMA2000 1XRTT	307 kbps		307 kbps	
CDMA2000 EV-DO Rel 0	2.4 Mbps	> 1 Mbps peak	153 kbps	150 kbps peak
CDMA2000 EV-DO Rev A	3.1 Mbps	> 1.5 Mbps peak 600 kbps to 1.4 Mbps typical[40]	1.8 Mbps	> 1 Mbps peak 300 to 500 kbps typical
CDMA2000 EV-DO Rev B (3 radio channels MHz)	14.7[41] Mbps		5.4 Mbps	
CDMA2000 EV-DO Rev B Theoretical (15 radio channels)	73.5 Mbps		27 Mbps	
WiMAX Release 1.0 (10 MHz TDD, DL/UL=3, 2x2 MIMO)	46 Mbps	1 to 5 Mbps typical[42]	4 Mbps	
WiMAX Release 1.5	TBD		TBD	
IEEE 802.16m	TBD		TBD	

*Blue: indicates theoretical peak rates; Green: indicates typical peak rate

[35] HSPA consists of systems supporting both HSDPA and HSUPA.
[36] Typical downlink and uplink throughput rates based on AT&T press release, June 4, 2008
[37] 3G Americas analysis. Assumes Release 7 with 64 QAM and F-DPCH. Single user. 50% loading in neighboring cells. Higher rates expected with subsequent versions.
[38] Vodafone press release, "Vodafone Trials HSPA+ Mobile Broadband at Speeds of Up To 16Mbps," January 15, 2009.
3G Americas' member company analysis. Assumes single user with 50% load in other sectors. Verizon is quoting average user rates of 5-12 Mbps on the downlink and 2-5 Mbps on the uplink for their network. https://www.lte.vzw.com/AboutLTE/VerizonWirelessLTENetwork/tabid/6003/Default.aspx
[39] Assumes 64 QAM. Otherwise 22 Mbps with 16 QAM.
[40] Typical downlink and uplink throughput rates based on Sprint press release January 30, 2007.
[41] Assuming use of 64 QAM modulation.
[42] WiMAX Forum, http://www.wimaxforum.org/resources/frequently-asked-questions

CONCLUSION

During 2010, the mobile broadband industry grew rapidly with data intensive smartphones on track to becoming the most common phone type used in developed countries and with innovative new devices such as the Apple iPhone4 and iPad. 3G is becoming ubiquitous in developed countries, and advanced wireless technologies such as LTE are starting to see initial rollouts. The growing success of mobile broadband, however, has mandated the network requirement to increase capacity to which the industry has responded by using more efficient technologies, deploying more cell sites, and offloading onto either Wi-Fi or Femtocells. Governments have also responded with supportive planning to supply more commercial spectrum.

By means of constant innovation, the EDGE/HSPA/LTE family of technologies has proven itself to be the predominant wireless network solution and offers service providers and subscribers a true mobile broadband capability. Continued use of GSM and EDGE technology through ongoing enhancements allows service providers to leverage existing network investments. UMTS-HSPA technologies' advantages provide broadband services that deliver increased data transport and provide a path to an all services IP architecture.

LTE is currently the most widely chosen technology platform for the coming decade and with deployment underway, the benefits include a best practice, long-term solution that meets or exceeds the performance of competing approaches. The migration to 4G, however, is a long-term one. Until the middle of this decade, most subscribers will still be using 2G and 3G. Significant uptake of LTE may not occur until the second half of this decade.

Today, HSPA offers the highest peak data rates of any widely available, wide-area wireless technology. With continued improvements, peak data rates will increase, spectral efficiency will improve, and latency will decrease. The result will be support for more users and more data intensive applications. The scope of applications will also increase as new services, achieved through standardized network interfaces, become available such as location information, video, and user initiated call control. Greater efficiencies and capabilities translate to more competitive offers, greater network usage, and increased traffic.

Because of practical benefits and deployment momentum, the migration path from EDGE to HSPA, and then to LTE is foreseeable. Benefits include the ability to roam globally, large economies of scale, widespread acceptance by service providers, paired services like messaging and multimedia, and an incredible variety of competitive handsets and other mobile user devices. Currently, more than 347 commercial UMTS-HSPA networks are already in operation. UMTS-HSPA and/or LTE offers an excellent migration path for GSM service providers, as well as an effective technology solution for greenfield providers.

HSPA has significantly enhanced UMTS by providing a broadband data service with user rates that often exceed 1 Mbps on the downlink in initial deployments and that now exceed 4 Mbps in some commercial networks. Numerous networks are being upgraded to include HSUPA, providing users with uplink rates in excess of 1 Mbps. HSPA+ increases rates further, with typical rates between 1.9 and 8.8 Mbps expected in initial versions of the technology (based on 64 QAM). Speeds will only increase as service providers implement other HSPA+ innovations such as Dual-Carrier, Multi-Carrier[43], and MIMO.

Continual improvements in radio technology are expected. Improvements to the core network through flatter architectures, particularly EPC, that will reduce latency, speed applications, simplify deployment, enable all services within the IP domain, and allow a common core network to support both LTE and legacy architectures is also anticipated.

Networks are rapidly moving toward providing the "always on, anywhere, anytime", type of communications support, with corresponding increases in traffic demanded by users in developed countries. Network limitations are constantly being addressed with solutions that make this vision a reality. Users will expand to include device-to-device applications, thus expanding point-to-point and point-to-multipoint communications. Smart homes, smart appliances, cars, and sensors are among the new communications devices that are a part of the communications explosion. The number and types of devices that communicate will grow rapidly once the network supports the volume at a reasonable cost. The way we communicate is set to change drastically.

"What works on the net works for people in general. The net has very little to do with technology, what matters is how people use the technology."

~ Craig Newmark, Founder, Craigslist

[43] Multi-carrier modulation (MCM) is a method of transmitting data by splitting it into several components, and sending each of these components over separate carrier signals. The individual carriers have narrow bandwidth, but the composite signal can have broad bandwidth.

IMS Mini Tutorial

The benefits of using IMS include handling all communication in the packet domain, tighter integration with the Internet, and a lower cost infrastructure that is based on IP building blocks used for both voice and data services. This allows operators to potentially deliver data and voice services at a lower cost, thus providing these services at cheaper prices and further driving demand and usage.

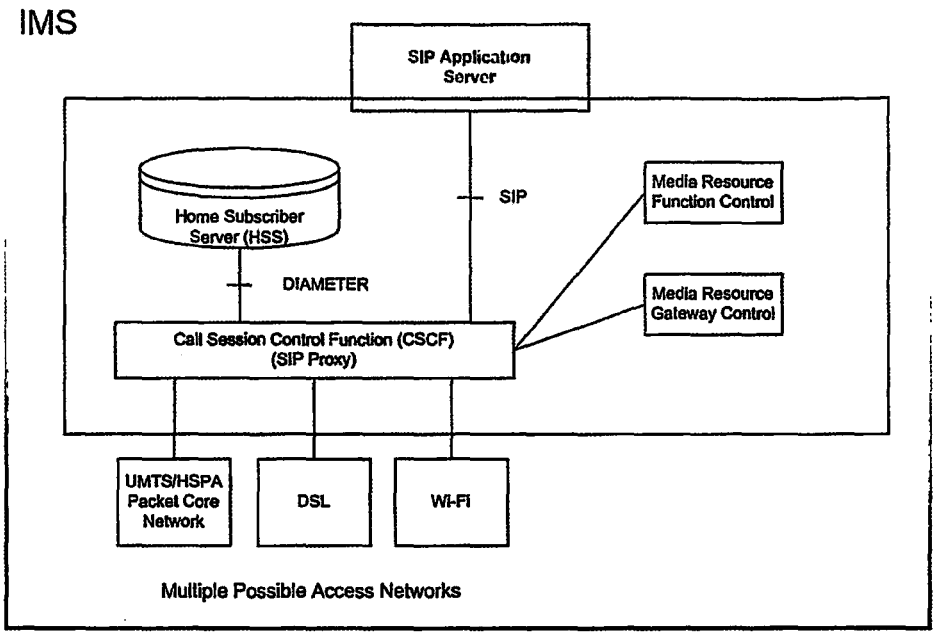


Figure 3-3 IP Multimedia Subsystems

IMS applications can reside in the operator's network or in third-party networks including those of enterprises. By managing services and applications centrally—and independently of the access network—IMS can enable network convergence. This allows operators to offer common services across 3G, Wi-Fi, and wireline networks.

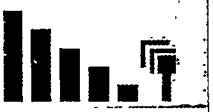
IMS is one of the most likely methods that operators will use to provide voice service in LTE networks. Service Continuity, defined in Release 8, allows a user's entire session to continue seamlessly as the user moves from one access network to another. Release 9 expands on this concept to allow sessions to move across different device types. For example, the user could transfer a video call in midsession from a mobile phone to a large-screen TV, assuming both have an IMS appearance in the network.

Release 8 introduces the IMS Centralized Services (ICS) feature, which allows IMS controlled voice features to use either packet-switched or circuit-switched access.

GOOGLE LATITUDE GAINS CHECK-INS; MAY ALSO GET LOCAL DISCOUNTS[44]

Google has finally hopped onto the check-in bandwagon, with extra twists that make it more appealing than many of the other options. Google Latitude, a location-based social media service, has been updated to support check-ins at local businesses. Latitude may be integrated with Google's soon-to-be introduced discount service, Google Offers. Users could share their locations with friends and family and check-in at various locations, such as coffee shops and art museums. It also allows them to post photos and comments about what they're doing and lets their friends see exactly where they are instead of just an abstract location on a map. Latitude allows users' phones to automatically check-in for them and sends notifications to users to remind them to check-in when the app detects that they have arrived somewhere. It also checks users out of a place once their GPS location shows that they have left. A FourSquare style "status" game has been added for extra appeal.

[44] http://arstechnica.com/gadgets/news/2011/02/google-latitude-gains-check-ins-may-also-get-local-discounts.ars



4. LONG TERM EVOLUTION

EXECUTIVE SUMMARY

The Third Generation (3G) to Fourth Generation (4G) evolution may be the most dramatic change that has been intiated by the wireless industry. Carriers are deploying wireless networks that rely on an all-Internet Protocol (IP) core that transmits information in the form of data traffic. The new 4G network is evolving with fewer nodes and a flatter structure, thus providing lower latency. 4G improves on the limitations of 3G by increasing access speeds and addressing network throughput, making better use of network resources, and improving Quality of Service (QoS).

Long Term Evolution (LTE) is seen as the next technology for mobile networks. It includes promising features such as semi-persistent scheduling[1], Transmission Time Interval (TTI) bundling[2], and high performance gains on Quality of end user Experience (QoE).[3] The primary objective of LTE is to provide ultra-high speed mobile broadband service with peak data rates over 100 Mbps. One of the main selling points of LTE is that it is supposed to encourage and foster new business models for mobile operators, especially as certain aspects of the competing WiMAX technology are specifically intended to enhance flexibility. In practical applications, however, LTE is challenged to provide the same capabilities as a 2G/3G network during the initial stages of trial deployments and during the service providers' initial broad network build out.

A major area of innovation and opportunity for telecom services is being termed "Voice 2.0", also known as "voice mashups". This involves linking voice with other applications (e.g., embedding voice capabilities within a corporate application or game). A call might be invoked inside a browser or Web application, either residing on the handset or the network side. There is huge interest by service providers in monetizing their voice capabilities beyond mere "person to person telephony". However, one of the concerns regarding LTE is the support for voice services. Wireless network architects see voice as just another application on the network. Voice continues to be the "killer application" for service providers because it continues to provide a significant portion of their revenue. Voice will remain the dominant critical service in the wireless network for years, and despite the technical challenges of providing service over an all-IP Radio Access Network (RAN)[4], voice will be a basic service for the customer. However, voice service continuity is not guaranteed if a Voice over IP (VoIP) subscriber roams between the LTE coverage area and other wireless networks, as it is a significant challenge to deliver voice over LTE networks. Unlike previous generations of mobile standards like Global System for Mobile Communications (GSM), LTE does not have dedicated channels for circuit-switched (CS) telephony, and instead relies on an end-to-end IP connection from the handset to the core network. Therefore, any form of voice service used on an LTE bearer, by definition, must be some form of VoIP.

The industry is evaluating potential solutions to overcome the LTE voice issues. During this investigative process, two options are viewed with significant interest: Circuit Switched Fall Back (CSFB)[5] and LTE VoIP-based Single Radio Voice Call Continuity (SRVCC). SRVCC provides the ability to transition a voice call from the VoIP/IMS packet domain to the legacy circuit domain, (the ability to transition from the circuit domain to the packet domain is not addressed in the current generation of LTE standards). IMS is a platform that permits data sessions to be supported across telecom networks. IMS architecture may potentially allow a call to begin in the home using a wired network, transfer seamlessly to a mobile device, and then move uninterrupted into a corporate wired or wireless environment. SRVCC is broadly supported in the industry and is recommended by the LTE OneVoice Initiative. It is also supported by some of the world's largest service and network equipment providers and has been endorsed by the GSM Association (GSMA).

WHY SRVCC?

Multimedia services with video sharing, video on demand, video telephony, video conferencing, VoIP, Push-To-Talk, broadband access to Personal Digital Assistants (PDAs), and many other applications are currently offered with the existing capabilities of the Universal Mobile Telecommunications System (UMTS) using High Speed Packet Access (HSPA), Evolved HSPA (HSPA+), Code Division Multiple Access (CDMA), and IP MultiMedia Subsystems (IMS) technologies. Increased demand for these real-time mobile data services coupled with subscribers' requirements for always-on, high-quality

[1] Semi-persistent scheduling reduces control channel signaling. If every allocation was individually signaled, the overhead would be unacceptable. In an application such as voice over IP, for example, a downlink frame occurs every 10 to 20 milliseconds. If each downlink frame were signaled individually, it would cause a lot of traffic on the control channel and the control channel would need a lot more bandwidth than necessary. Semi-persistent scheduling lets you set up an ongoing allocation that persists until it is changed. Semi-persistent schedules can be configured for both uplink and downlink.

[2] TTI, Transmission Time Interval, is a parameter in UMTS (and other digital telecommunication networks) related to encapsulation of data from higher layers into frames for transmission on the radio link layer. TTI refers to the length of an independently decodable transmission on the radio link. The TTI is related to the size of the data blocks passed from the higher network layers to the radio link layer.

[3] "Quality of User Experience," is a subjective measure of a customer's experiences with a vendor.

[4] Sits between the Mobile phone, and the core network (CN).

[5] 3GPP designation as specification 23.272. It uses various network elements and procedures to move the handset radio.

services is driving the need for expanded network capacity and increased throughput.

However, along with added "Voice 2.0" services, another slowly emerging trend which could be extinguished by CSFB is that of the shift towards "high definition" voice. Although this has been widely used in the VoIP community for years, it has taken a long time to penetrate the mobile marketplace, despite being technically feasible.

With LTE's increased data transmission capacity, inter-working with 3rd Generation Partnership Project (3GPP) and non-3GPP based networks, and all-IP core network elements, the converging services can be delivered effectively. Higher bandwidth for LTE means that more resource blocks[6] can be allocated by the LTE system, which in turn provides higher performance gains.

Recognizing this reality, CSFB is a 3GPP-defined standard that requires radio devices to be equipped with either dual-mode/single-standby or dual-mode/dual-standby capabilities. In addition to CSFB, a number of other interim technologies have been suggested:

- Voice over LTE via GAN (VoLGA) encapsulates circuit voice within an IP Protocol Security (IPsec) tunnel over the LTE bearer. It is an evolution of the voice-over-WiFi standard UMA (standardized by 3GPP as Generic Access Network (GAN)), which has existed for a few years, however, with limited traction. It enables the normal telephony and SMS[7] application on the phone to connect over an IP connection to the existing Mobile Switching Center (MSC), via a gateway and handset client.

Figure 4-1 displays the reference architecture for a CSFB network using an Evolved

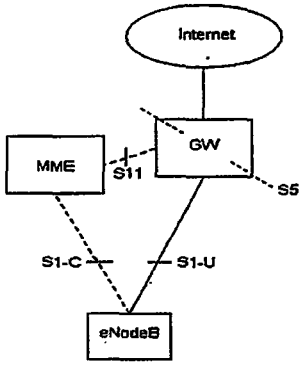


Figure 4-1 EPS Reference Architecture for CSFB with UTRAN as Destination Network

Packet System (EPS)[8] with the 3GPP Universal Terrestrial Radio Access Network (UTRAN).

For dual-mode/single-standby mobile phones to simultaneously use dual-network services, the Inter Working Solution (IWS) node provides on-time message access. On the other hand, dual-mode/dual-standby mobile phones require fewer network changes to facilitate inter-working between two networks. Dual-mode handsets drain battery power quickly and need complex terminal customization.

For converging mobile and broadband wireless access technologies, SRVCC offers LTE-IMS based voice service within the LTE coverage area, and CS-based voice service outside the LTE coverage area. The following figure displays the reference architecture for SRVCC using EPS to 3GPP UTRAN.

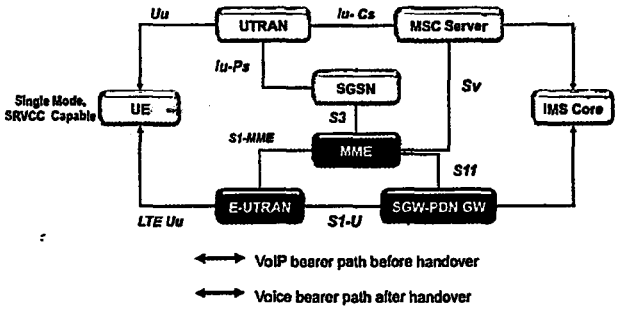


Figure 4-2 EPS Reference Architecture for SRVCC to UTRAN as Destination Network

Whenever the VoIP subscriber moves out of LTE coverage, SRVCC ensures smooth handoff of voice from the LTE to the CS network, keeping upgrades of the network to a minimum. The IMS network that stores voice service link information during this time guides the target CS network to establish a link, thereby replacing the original VoIP channel.

Table 4-1 CSFB vs. SRVCC

PARAMETER	SRVCC	CSFB
Device/terminal capability	Single radio mode	Dual-mode/ single-standby or Dualmode/dual-standby
Terminal customization	Less complex	Complex for single standby
IMS anchoring	Mandatory	Optional
Switching networks/mobility to CS network	Only when the terminal roams out of LTE coverage area	For every mobile originating and mobile terminating voice call

[6] Resource blocks are groups of transport carriers (e.g. sub-carriers) or intervals that are assigned to transport data. A resource block for UMTS LTE is 12 sub-carriers when the sub-carrier bandwidth is 15 kHz or 24 sub-carriers when the sub-carrier bandwidth is 7.5 kHz.

[7] SMS-over-SGs approach has some significant limitations even when used without fallback, resolutions to which are still only now being discussed in standards bodies. Problems relate to provision of information for charging purposes, "message waiting" signals and delayed delivery when a mobile is out of coverage, sending multiple "concatenated" SMS messages, multiple-addressing of sent messages, and location data (important for lawful interception).

[8] In its most basic form, the EPS architecture consists of only two nodes in the user plane: a base station and a core network Gateway (GW).

PARAMETER	SRVCC	CSFB
Cost	Less expensive	Expensive due to increased network signaling load
Voice call setup time	Less, as time is required only when the terminal moves out of LTE coverage area	More, as the terminal needs to establish the voice call session with CS network for every access

SRVCC from LTE

SRVCC service for LTE is important when a single radio User Equipment (UE) accessing IMS anchored voice call services switches from the LTE network to the CS domain, while it is able to transmit or receive on only one of these access networks at a given time. This basically removes the need for a UE to have multiple Radio Access Technology (RAT) capabilities. With single-radio terminals, measurement gaps are needed to allow the UE to switch onto the CS network and complete radio measurements. Measurement gaps define the time periods when no uplink or downlink transmissions are scheduled so that the UE may perform the measurements. However, it is understood that the idea of CSFB fits very poorly with LTE femtocells. An LTE device camped onto a femto would either need to fallback to 2G/3G in the femto itself, or look for a macro cell-site instead. Adding 2G into femtos is extremely complex, while adding 3G increases cost, complexity and time-to-market. Conversely, accessing the macro network is obviously dependent on coverage, and may have a huge performance gap with the femto for data services running in parallel.

The Evolved NodeB (eNodeB), (i.e., LTE base station) is responsible for configuring the measurement gap pattern and provides it to the UE using Radio Resource Control (RRC) dedicated signaling. The UE assists the eNodeB by informing the network about its gap-related capabilities, at least mentioning if it has a dual or single receiver. This capability is transferred along with the other UE capabilities. The UE accessing the SRVCC service is assumed to have IMS Service continuity capabilities with single radio access only.

SRVCC from LTE to 3GPP2 1XCS

In the case of VoIP, when subscribers geographically roam from LTE+CDMA to CDMA, voice calls are switched from a VoIP to a CDMA 1x network using SRVCC technology. The existing inter-frequency/RAT gap pattern mechanism in E-UTRAN is therefore extended to support gap patterns suitable for 1xRTT measurements.

With this approach, the eNodeB is able to interwork with the 3GPP2 1XRTT MSC using the S1-MME interface with the Evolved Packet Core (EPC) Mobility Management Entity (MME).

Mobility Management Entity (MME): The MME manages mobility. Some of MME's functions are:

- NAS signaling and related security
- Inter CN node signaling for mobility between 3GPP access networks (terminating S3)
- Idle mode UE Tracking and Connectivity (control and execution of paging retransmission)
- Tracking Area list management
- Roaming (terminating towards home HSS)
- Gateway (GW) selections (serving GW and PDN GW selection)
- MME selection for handovers with MME change
- Serving GPRS Support Node selection for handovers to 2G or 3G 3GPP access networks
- High Rate Packet Data (HRPD) access node (terminating reference point) selection for handovers to/from HRPD
- Authentication
- Bearer management functions including dedicated bearer establishment
- Lawful interception of signaling traffic
- Support for Single Radio VCC and CS Fallback for 2G/3G and 1xRTT CDMA

A new Interworking Signaling (IWS) node is required and is responsible for the exchange of 3GPP 1XCS signaling messages with the MME and for establishing a CS session when the UE is in the process of switching over from the LTE network to the 3GPP 1XCS network. Generally, this is a case of intersystem handover from the LTE perspective.

A new S102 reference point or interface is defined between the LTE MME node and the 3GPP 1XCS IWS node. The 3GPP 1XCS signaling messages are tunneled over this single link of S102 and thereafter, tunneled through E-UTRAN/EPS tunneling messages to the UE.

EVOLVED PACKET SYSTEM (EPS) ACCESS

The following process identifies the actions taken by the network to seamlessly hand off voice calls from a VoIP network to a CS network:

1. 1xCS SRVCC UE sends measurement reports to the eNodeB.
2. The E-UTRAN makes a determination to initiate an inter-technology handover to CDMA2000 1xRTT.
3. The E-UTRAN signals the UE to perform an inter-technology handover by sending a Handover from E-UTRAN Preparation Request message with 3G1x Overhead Parameters.
4. The UE initiates signaling for establishment of the CS access leg by sending an Uplink handover preparation message containing the 1xRTT Origination message.
5. The E-UTRAN sends an Uplink S1 CDMA2000 Tunneling message with Mobile Equipment Identifiers (MEID), 1x Origination, Reference Cell ID to the MME. The eNodeB will also include CDMA2000 Handover Required Indication Information Element (IE) to Uplink S1 CDMA2000 Tunneling message, which indicates to the MME that the handover preparation has started.
6. On receipt of the Uplink S1 CDMA2000 Tunneling message, the MME:

- Separates the voice bearer from the non-voice bearers based on the QoS Class Identifier (QCI) associated with the voice bearer (QCI 1) and CDMA2000 HO Required Indication.
- Selects the 3GPP2 1xCS IWS based on Reference Cell ID and encapsulates the 1x Origination Message along with the MEID and Authentication Challenge Parameter, RAND, in a Direct Transfer message (as "1x Air Interface Signaling") to the IWS, only for the voice bearer.

7. The traffic assignment is done between the IWS and RTT MSC, over the A1 interface using the signaling protocols to initiate the handoff to the 1XRTT system.
8. The traffic channel resources are established in the 1x RTT system and 3GPP2 1xCS procedures for initiation of session transfer for CS access leg are performed.
9. When the 1xRTT MSC receives a positive acknowledgment from the 1xRTT radio for traffic allocation and from the IMS for successful domain transfer, it returns an IS-41 handoff message to the IWS to send to the UE via the established signaling tunnel.
10. The 3GPP2 1xCS IWS creates a 1x message and encapsulates it in a S102 Direct Transfer message (1x, Handover indication). If the 3GPP2 access was able to allocate resources successfully, the 1x message is a 1x Handover Direction message and the handover indicator indicates successful resource allocation. Otherwise, the handover indicator indicates to the MME that handover preparation failed and the embedded 1x message indicates the failure to the UE.
11. The MME sends the 1x message and CDMA2000 HO Status IE in a Downlink S1 CDMA2000 Tunneling message to the E-UTRAN. The CDMA2000 HO Status IE is set according to the handover indicator received over the S102 tunnel.
12. If the CDMA2000 HO Status IE indicates successful handover preparation, the E UTRAN forwards the 1x Handoff Direction message embedded in Mobility from E-UTRA Command message to the UE. This is perceived by the UE as a Handover Command message.
13. The UE tries to acquire the traffic channel with the 1xRTT CS access as it becomes aware of the traffic channel information from the CDMA2000 1xRTT system.
14. The UE sends a 1xRTT handoff completion message to the 1xRTT CS Access.
15. The 1xRTT CS Access sends a message to the 1xRTT MSC to indicate that the handoff is done. The traffic assignment, that was done during the session/domain transfer of the CS access leg, between the 1xCS IWS and the 1xRTT MSC, is released.
16. An ongoing voice call over the CS access leg is established over 1xRTT access. The UE continues to transmit voice via the new access system. The voice bearer path is no longer carried by the EPC.
17. The eNodeB initiates the release of UE context on the EPS; it sends an S1 UE Context Release Request (Cause) message to the MME. Cause indicates that S1 release procedure is due to handover from E-UTRAN to 1xRTT.
18. The MME exchanges Suspend Request and Suspend Acknowledge messages with the Serving Gateway (S-GW). With this, the S1-U bearers are released for all EPS bearers and the Guaranteed Bit Rate (GBR) bearers are deactivated by the MME. The non-GBR

bearers are preserved and are marked as suspended in the S-GW. Upon receipt of downlink data, the S-GW should not send a downlink data notification message to the MME.

Serving Gateway: The S-GW is the node that terminates the interface towards E-UTRAN. For each UE associated with the EPS, at a given point of time, there is a single S-GW. Serving GW functions include:

- The local Mobility Anchor point for inter-eNodeB handover
- Mobility anchoring for inter-3GPP mobility (terminating and relaying the traffic between 2G/3G system and PDN Gateway)
- E-UTRAN idle mode downlink packet buffering and initiation of network triggered service request procedure
- Transport level packet marking in the uplink and the downlink (e.g., setting the DiffServ Code Point, based on the QCI[9] of the associated EPS bearer)
- Accounting on user and QCI granularity for inter-operator charging
- [redacted]
- Packet routing and forwarding
- Some charging support

19. UE Context in the eNodeB and MME are now released with the normal E-UTRAN/EPS procedure.

CONCLUSION

The popularity of VoIP applications, along with the absolute need for service providers to deliver voice over LTE, is causing the SRVCC to receive significant attention. Despite the fact that SRVCC is apparently more complex than CSFB due to the requirement of an IMS core network (or application tier), it continues to be the choice of the LTE OneVoice initiative due to the lack of need for complex and expensive dual-mode user devices. To combat the apparent cost and complexity of a full IMS network rollout, the industry is now focusing on simplifying the IMS protocols and defining a specific IMS "profile" for providing seamless LTE VoIP service.

SRVCC will play a key role in handing over the UE from LTE to other CS-based networks by utilizing high performance technology capabilities of LTE and the EPC. When there are competitive solutions, different service providers will likely choose to implement one or the other depending on many factors including existing network assets and the overall requirements for rolling out LTE. CSFB may be used by a subset of service providers as it requires less core network modification and changes can be focused primarily on the handset manufacturers. Due to the efforts of the LTE OneVoice initiative and the capability to deliver SRVCC via a subset of IMS functionality, it is forecasted that the majority of LTE voice service will be provided using an IMS-based SRVCC architecture.

In current form, CSFB may be unsuitable as a broadly-deployed interim solution, especially for LTE service providers that do not expect a swift transition to IMS. While it may be made workable for certain service providers that retain control of handset software, and an entrenched business model that supports the ability to provide a highly-customized user experience, it has severe deficiencies for many others. While there are likely to be some work arounds and enhancements to CSFB to address some of the problems, it seems unlikely that these will solve all the concerns raised.

For service providers that want to retain control over in-house voice applications and which have robust CS platforms with several years working life and spare capacity left in them, VoLGA maybe a realistic option – or at least one worthy of formal investigation and testing, as well as greater attention from the standards bodies. It is certainly not without its own challenges. It also requires changes to handsets, as well as a mechanism for allowing the network to trigger LTE-to-3G/2G handovers for VoLGA calls, originally defined as part of SRVCC. It is also purely a mechanism for delivering "old school" CS-type voice services rather than the more advanced types of Web/voice integration, although potentially the voice traffic could be treated as a packet application/object available over IP.

The introduction of seamless high speed networking offers service providers the ability to customize billing specific to a customer usage. Blending pre and postpaid services, and pay-per-use, (e.g., billing for mega-bytes transmitted) [redacted]

[9] QCI=QoS Class Identifier (3GPP)

5. 4G TECHNOLOGY

INTRODUCTION

For some time now, marketers in the telecommunications industry have offered the promise of Fourth Generation (4G) networks bringing the full power of the Internet to the world of wireless. But what does 4G really mean? Is it more than just a promise? Most importantly, how will it impact Law Enforcement's (LE) ability to perform electronic intercepts? This article examines the evolving definition of 4G, describes what is really happening on the network, and identifies the specific challenges that the deployment of 4G networks could pose for LE.

THE GENERATION GAP

Generations represent major advances in technologies and services. As such, the term is often freely used by those who wish to portray their offerings as major improvements to what is currently considered state of the art. Often these changes prove to be incremental at best, and soon enough another company is touting their own products as part of the next generation. Such uses of Third Generation (3G), and now 4G, as marketing terms lead to confusion within the marketplace. Usually, it is only over time that the industry converges on an accepted definition of the characteristics of a generation of telecommunications technology. 4G is just reaching that stage. While there is much marketing hype, agreement on what technologies meet the definition of 4G is just now emerging.[1]

THE TECHNOLOGIES

Global System for Mobile (GSM): The dominant mobile phone technology worldwide is GSM, which has over 85% of the three billion (and growing) subscriptions worldwide.

Universal Mobile Telecommunications System (UMTS): This 3G mobile phone system evolved from GSM by replacing the radio subsystem with one based on Code Division Multiple Access (CDMA), which offers higher capacity and performance than Second Generation (2G). By squeezing more phone calls into the same spectrum, fewer cell sites are required or higher data rates can be achieved. Almost all UMTS networks are owned by or directly interwork with an existing 2G GSM network so that in areas with poor coverage, calls can be handed over to and continue on the other network.

High Speed Packet Access (HSPA): Often termed 3.5G, this is an improved version of UMTS that modifies the coding used on the radio transmissions to dramatically improve the data throughput. Peak rates of 14 Megabits per second (Mbps) are achievable in lab conditions, with promises of even higher capacity. These systems are completely backward compatible with the original UMTS systems, although, newer handsets or data dongles would be required to take advantage of the higher data rates. Earlier versions of (non-mobile) WiMAX are considered 3-3.5G.

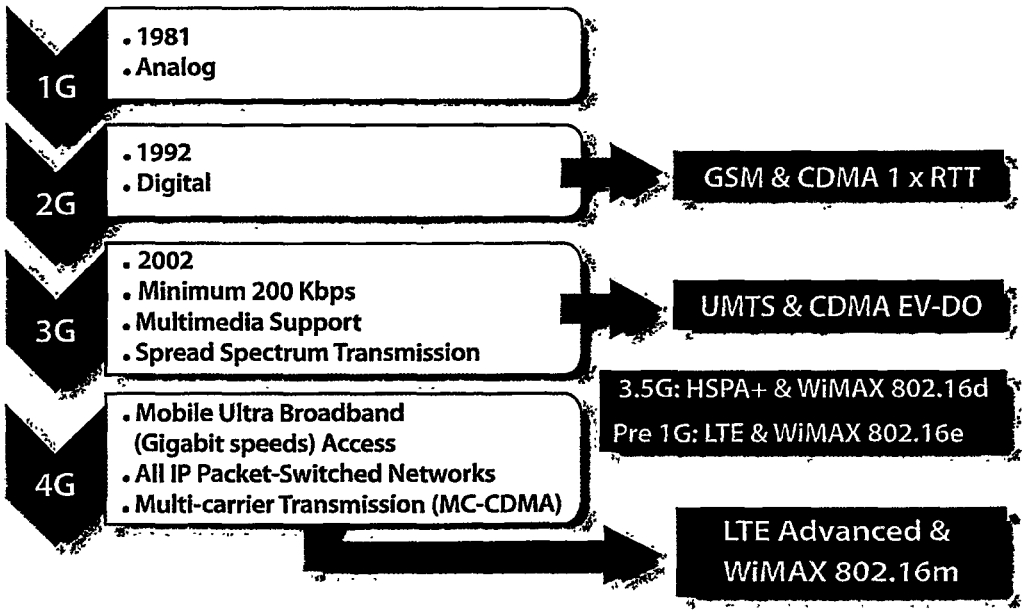


Figure 5-1 Evolution to 4G

[1] http://www.fiercebroadbandwireless.com/story/itu-declares-lte-advanced-802-16m-4g-standards/2010-10-25

Code Division Multiple Access (CDMA): Not to be confused with Wideband CDMA (WCDMA), this earlier technology was popular in the U.S., Japan, and Korea but did not achieve global deployment. The 2G version of CDMA is known as One times Radio Transmission Technology (1xRTT) and is efficient for voice and text services. The 3G version, called Evolution-Data Optimized or Evolution-Data Only (EV-DO), provides high-speed data rates.

Long Term Evolution (LTE): Both GSM and CDMA communities have agreed to move toward a common standard for their next step. LTE is their 4G standard, and radio interface has already demonstrated data rates over 100 Megabits per second (Mbps). The Orthogonal Frequency-Division Multiplexing (OFDM) scheme is particularly effective at combating multi-path and other aspects where radio propagation is difficult. There will also be a major change to the core network standard, which is called System Architecture Evolution (SAE) and uses the Session Initiation Protocol (SIP) to setup sessions and voice calls.

Worldwide Interoperability for Microwave Access (WiMAX): This is also an OFDM technology and competes with LTE, although, there are talks to combine the two. It is marketed as a low-cost means of delivering broadband data services, is likely to be popular in areas where there are no landline alternatives, and is a competitor to HSPA and LTE.

A summary of the key aspects of the four widely acknowledged generations of telecommunications technology is shown in Figure 5-1. The key aspects of 4G wireless networks that distinguish them from widely deployed 3G networks are:

- Gigabit (GB) wireless data rates – one to two orders of magnitude faster than the most advanced 3G or 3.5G networks[2]
- All Internet Protocol (IP)-switched networks – rather than the mixed circuit and packet nature of 3G networks
- Multi-carrier transmission – allows more efficient use of available radio access network bandwidth

In October 2010, the ITU declared that only two technologies meet its definition of 4G[3] - LTE Advanced and WiMAX 2 (based on the IEEE 802.16m air interface standard). Neither of these technologies has been deployed. LTE (not LTE Advanced) is moving toward deployment in 2011 with LTE Advanced deployment projected to begin in 2012. WiMAX 1.x (based on IEEE 802.16e) has been deployed in the U.S. and worldwide, with WiMAX 2 deployments projected to begin before the end of 2011.[4]

LTE EVOLUTION

- The term LTE originally referred to the Evolved UMTS Terrestrial Radio Access Network (E-UTRAN)
  - E-UTRAN was designed to offer high-speed broadband access equivalent to the higher end of Digital Subscriber Line (DSL) and cable connections
- LTE is now used as a 4G marketing term for the Evolved Packet System (EPS)
  - EPS = E-UTRAN + the Evolved Packet Core (EPC)
  - EPC is the result of the SAE, which optimized an all-packet core network to accommodate higher access speeds and larger volume data network sessions
- Initial LTE deployments use the 700 Megahertz (MHz) band
- LTE supports Voice (IP Multimedia Subsystems (IMS) VoIP) and data
  - Initial deployments may also support Circuit Switched (CS) fallback for voice

WIMAX EVOLUTION

- 802.16d fixed WiMAX; mobility added in 802.16e
- Sprint's Xohm WiMAX offering ranges between 3.7 – 5 Mbps
- Developing 802.16m with average downlink speeds greater than 100 Mbps
- WiMAX initially supported data only
  - VoIP was provided by third-parties
- WiMAX currently developing WiMAX VoIP Capability

WHO IS DEPLOYING LTE IN THE US?[5]

Verizon conducted successful user LTE (not LTE Advanced) usability tests in five markets in June 2010. On December 1, Verizon announced that it will roll out LTE service in 38 U.S. markets by the end of 2010 and extend the network to reach all of its existing 3G coverage areas by 2013.[6]

[2] EV-DO Rev B offers downstream data rates up to about 14.7 mbps. HSPA+ in theory can provide downstream rates up to 56 mbps, but has achieved only about 28 mbps in existing deployments – Wikipedia "3G Networks"

[3] http://www.engadget.com/2010/10/21/itu-lays-down-law-wimax-2-lte-advanced-are-4g-everyone-else-i/

[4] http://www.wimaxforum.org/sites/wimaxforum.org/files/document_library/wimax_hspa+and_lte_111809_final.pdf

[5] http://www.informationweek.com/news/hardware/handheld/showArticle.jhtml?articleID=225701635
http://connectedplanetonline.com/ctia/2010/news/aircom-fast-tracking-us-lte-rollouts-0322/
http://connectedplanetonline.com/independent/news/centurytel-2010-lte-rollout-0219/index.html (Feb 09)
http://www.4ginfo.com/index.php/centurytel-to-offer-fixed-line-lte-as-soon-as-2010.html
http://www.slashgear.com/metropcs-lte-network-arriving-2h-2010-with-samsung-sch-r900-2478981/
http://blog.laptopmag.com/att-14-4mbps-hspa-to-cover-250-million-people
http://gigaom.com/2010/01/25/forget-cables-wimax-dreams-cox-trials-lte-network/

[6] http://www.thetechherald.com/article.php/201048/6493/Hands-on-with-Verizon-s-speedy-LTE-4G-network

Cox Communications conducted LTE trials in Phoenix and San Diego beginning in January 2010. In November 2010, it announced the start of service in three areas: Hampton Roads, VA, Omaha, NE, and Orange County, CA.[7]

MetroPCS launched its LTE rollout in September 2010 in Las Vegas with promises to add at least 10 more markets "soon".[8]

Centurytel announced plans to roll out LTE in 2010 for broadband, but not wireless.

AT&T plans a mid-2011 deployment and is conducting trials in Baltimore and Dallas.[9] The company is deploying HSPA+ prior to its LTE launch and is working out its LTE deployment strategy to ensure that voice and data services can work simultaneously on UMTS and LTE.

Despite T-Mobile USA's ongoing partnership negotiations with Clear (formerly Clearwire), a T-Mobile USA statement made in October 2010 indicated that while there is no pressure to transition to LTE, the carrier prefers LTE over WiMAX. T-Mobile did not make a definitive announcement on their future strategy.[10] T-Mobile is continuing its HSPA+ rollout; it currently has 55 markets on HSPA+ and plans to cover 100 major metropolitan areas by the end of 2010.

WHO IS DEPLOYING WIMAX IN THE US?[11]

Clear began WiMAX 1.x deployments in partnership with Sprint Nextel in 2008. Clear also has wholesale partnerships with Comcast and Time Warner Cable. By the end of June 2010, Clear had commercial WiMAX services available in 36 U.S. cities including: Atlanta, Baltimore, Chicago, Las Vegas, Philadelphia, Honolulu, Seattle, Dallas/Ft. Worth, and central Washington, DC. By the end of 2010, Clear plans to have service for: Los Angeles, Miami, New York City, Boston, Denver, and San Francisco amongst others.

Clear is also conducting LTE trials in Phoenix. If the company decides to switch from WiMAX to LTE, it would not be until 2012, at the earliest.[12] Reacting to changes in the market, Clear updated their agreement with Intel to allow either party to terminate their agreement with a 30-day notice, increasing the carrier's flexibility.

IMPACT OF 4G ON ELECTRONIC SURVEILLANCE

There are a number of ways in which 4G wireless technology could impact electronic surveillance. Many of these areas represent unknowns because standards for WiMAX 2 and LTE Advanced are still in development and vendor and service provider implementation and deployment plans are not known in detail.

Higher Data Rates

One notable impact is that Law Enforcement Agencies (LEAs) will need to deal with significantly higher data rates than in current wireless network intercepts. Managing this "fire hose" of data is complicated by the lack of buffering or reliable delivery requirements. In contrast to the CS environment, with packet-based communications, if critical packets are lost, entire streams of content can be rendered unintelligible. These higher data rates could place a greater emphasis on the filtering of data to identify specific content.

All IP and Multi-media

In the IP environment, all subject content will be embedded in a single packet stream. To perform VoIP intercepts, voice packets will need to be extracted from the packet stream in near real-time. Voice packets also may not include voice, exclusively. 4G wireless networks will support multi-media applications that combine voice and video or other media. Another aspect of the All IP network is that as users move, tunnels are used within the networks during handoffs to provide the mobile user's wireless communications (either voice or data sessions) with continuity. Tunnels within a network increase the complexity of lawful intercept (LI) solutions. Challenges imposed by tunneling may include difficulty in identifying the traffic of a particular user (e.g., deep packet inspection may be needed), accessing the content of a tunnel at its end-points, and the use of encryption within tunnels.

Multiple Subject Identifiers

Since service-related functions are independent from transport-related technologies, applications can be defined independently (at the service level) from the network. This results in a variety of identifiers being used in 4G wireless networks; different networks may use different identifiers (or different types of identifiers) for the same subject's intercepted communications. For example, access networks are likely to continue using IP addresses, but various identities may be associated with IMS:

- IP Multimedia Private Identity (IMPI)
- IP Multimedia Public Identity (IMPU)
- Globally Routable User Agent URI (GRUU)
- Wildcarded Public User Identity

[7] http://www.pcmag.com/article2/0,2817,2373038,00.asp
[8] http://www.fiercewireless.com/story/metropcs-launches-lte-las-vegas-promises-more-markets-soon/2010-09-21
[9] http://www.fiercewireless.com/story/t-launching-lte-mid-2011/2010-09-16
[10] http://www.fiercewireless.com/story/t-mobile-backs-lte-calls-wimax-niche-play/2010-10-01
[11] http://www.informationweek.com/news/hardware/handheld/showArticle.jhtml?articleID=225701635
[12] http://www.fiercewireless.com/story/clearwire-holding-any-lte-switch-until-2012/2010-05-10

The use of these identifiers could pose challenges for identifying a target's traffic by the service provider and correlation of data received by the LEA. It is not clear if the timing of the assignment of these identifiers aligns well with existing reporting capabilities.

Both IMPI and IMPU are not phone numbers or other series of digits, but Uniform Resource Identifiers (URIs) can be digits (a TEL URI, like tel: +1-555-123-4567) or alphanumeric identifiers (a SIP URI, like sip:john.doe@example.com).

IMS IDENTIFIERS

IP Multimedia Private Identity

The IMPI is a unique, permanently allocated global identity assigned by the home network operator and is used, for example, for registration, authorization, administration, and accounting purposes. Every IMS user has one or more IMPI. The IMPI is not accessible to the user and is only visible to control nodes inside the IMS.

IP Multimedia Public Identity

The IMPU is employed by a user to request communications with other users and takes the form of a SIP URI or a TEL URI. There can be multiple IMPU per IMPI. The IMPU can also be shared with another phone so that both can be reached with the same identity (e.g., a single phone number for an entire family). This identity is visible outside of the network. In the case of more than one IMS subscription, there may be a many-to-many mapping of Private User Identities to Public Users IDs.

Globally Routable User Agent URI

GRUU is an identity that classifies a unique combination of IMPU and UE instance. There are two types of GRUU: Public-GRUU (P-GRUU) and Temporary GRUU (T-GRUU). P-GRUU reveals the IMPU and is very long lived. T-GRUU does not reveal the IMPU and is valid until the contact is explicitly de-registered or the current registration expires.

Wildcarded Public User Identity

A wildcarded Public User Identity expresses a set of IMPU grouped together. The Home Subscriber Server (HSS) subscriber database contains the IMPU, IMPI, IMSI, and Mobile Subscriber ISDN Number (MSISDN), subscriber service profiles, service triggers, and other information. Although already a challenge today, other applications such as Web-based VoIP and instant messaging (IM), have introduced closed identifier schemes. These providers proprietarily manage the subscriber's identities, though those identities may or may not be mapped to SIP URIs. These additional identifiers will also need to be addressed in 4G LI solutions.

b7E

Access Level Interception May Not Be Sufficient

4G wireless networks support a broad range of interworking and service continuity capabilities across both service providers and technologies. This will add to the complexity of correlating different parts of a communication. The access and connectivity (core network) services may be provided by different service providers, thus, the access network may not have access to all content or signaling.

Growth of Machine-to-Machine Communication

Machine-to-machine (M2M) communications exist in earlier generations of wireless technology but are proliferating in 4G, particularly in WiMAX where they have become a significant focus area. M2M communications are used to support applications such as meter reading, tracking, building security and environmental control, fleet management, and remote payment.

"As a result of the increase in digital communications and the growing importance of digital evidence in all types of investigations, Regional Computer Forensics Laboratories continue to develop and deploy innovative digital forensics tools and services to meet law enforcement's needs."

~ Anthony P. DiClemente, Chief, Data Acquisition/Intercept Section

6. WIRELESS CELL PHONE TECHNOLOGIES: A SHORT TUTORIAL

INTRODUCTION

Today, wireless is not just a concept; it is a reality that is driving mobile technology to new levels of seamless mobility. With the emergence of higher bandwidth offered by the 802.11n standard and the explosion of mobile applications, there is a need for a new architecture to accommodate 802.11g's 54 Megabits per second (Mbps) to 802.11n's 300 Mbps and mobile cellular broadband.

BACKGROUND

What does wireless technology mean? And how did we arrive here?

In 1980, the First Generation (1G) wireless analog technology was the 'brick or bag phone' or 1G. 1G was replaced by the second generation (2G) cell phone advancing the technology from analog to digital and the introduction of Global System for Mobile Communications (GSM) standard on the 2G network. 2G also utilizes the following digital protocols: Code Division Multiple Access (CDMA), Time Division Multiple Access (TDMA), Integrated Digital Enhanced Network (iDEN), and Primary Domain Controller (PDC). In order to bridge the gap between 2G and the Third Generation (3G), the Interim Standard (2.5G) was created for marketing purposes. One major advance leading up to 3G is packet-switched systems. The transition from 2G to 3G enabled faster data transmission speeds and greater network capacity with more advanced services. The first commercial 3G launch was in Japan on October 1, 2001. Today, the future is looking to Fourth Generation (4G) or 'beyond 3G' with the cell phone evolving to replace 3G technology. The next generation promises higher data rates, and voice, data, and high-quality multimedia in real-time ("streamed") anywhere and anytime. 4G networks are forecasted to launch between 2012 and 2015.[1]

The Pew Research Center's Internet & American Life Project revealed that:[2]

- 82 percent of American adults own a cell phone
- Five percent of adult texters send more than 200 text messages per day
- Women tend to make slightly fewer calls than men; 26 percent of men say they make or receive 6 to 10 calls a day, while 20 percent of women make the same claim
- 91 percent of cell phone owners say their phones make them feel safer
- 42 percent of cell phone owners say they feel irritated when a call or text interrupts them
- 65 percent of adults say they have slept with their phone "on or right next to" their bed
- 72 percent of adult cell phone users send and receive text messages

HISTORY

How are Cellphones Different from Smartphones?

The first cell phone was demonstrated 19 years ago. Motorola employee Dr. Martin Cooper on April 3, 1973 called researcher Dr. Joel S. Engel of AT&T's Bell Labs using a prototype from Motorola called the DynaTAC.[3]

Less than 20 years later, IBM designed the first smartphone in 1992. It was called Simon. The smartphone was presented that year as a concept device in Las Vegas at the computer industry trade show known as COMDEX.

A smartphone is like a miniature computer that can place and receive calls. Smartphones use a mobile operating system (OS). A mobile operating system is much like what's powering your personal computer at home or at work. However, the software goes by different names. Cell phones don't have operating systems at all. Smartphones can be powered by:

- Windows Mobile
- iPhone OS
- Google's Android
- Symbian OS
- RIM's BlackBerry
- Palm's Web OS
- Linux

Cell phones can typically send and receive text, picture, and video messages, and some can email, too. Smartphones typically go a step further by syncing with the email server of your personal or corporate provider.

[1] http://cellphones.about.com/od/phoneglossary/tp/1g2g3g4g.htm
[2] http://cellphones.about.com/
[3] http://cellphones.about.com/od/coveringthebasics/qt/cellphonesvssmartphones.htm

Table 6-1 3G vs. 4G[4]

b7E

	3G	4G
Frequency Band:	*1.8 - 2.5 GHz*	*2 - 8 GHz*
Forward error correction (FEC):	*3G uses Turbo codes for error correction*	*Concatenated codes are used for error corrections in 4G*
Data Throughput:	*Up to 3.1 Mbps*	*Practically speaking, 3 to 5 Mbps but potential estimated at a range of 100 to 300 Mbps*
Services And Applications:	*CDMA 2000, UMTS, EDGE etc.*	*WiMax, LTE and Wi-Fi*

SPEED OF 3G VS. 4G

How much faster is 4G compared to 3G? Unfortunately for consumers, the answer to this question is more nuanced than one would like. The speed of a 3G network depends upon how it is implemented. In the U.S., by 2010 Sprint and Verizon (both CDMA networks) had reached the limits of how fast they could make their 3G networks. Upgrading to 4G networks allowed them to offer data transmission speeds up to four times faster than their 3G networks. However, the 3G networks of GSM carriers AT&T and T-Mobile were designed such that there was room to upgrade 3G speeds. As of mid-2010, it was anticipated that when AT&T and T-Mobile upgrade their 3G networks, their speeds will become comparable to 4G from Sprint and Verizon.

Design Principle and Applications

Both 2G and 3G networks were designed primarily for voice communications rather than data. On the other hand, 4G is designed especially for data transmission rather than voice. So, 4G offers faster access to data using mobile phones. For example, streaming video works better with 4G, with less stuttering and a higher resolution. Similarly, video conferencing and multi-player online games work better with the faster data transmission offered by 4G.

Relevance

The speed you ultimately experience on your mobile phone depends much more on factors other than "3G" or "4G". In theory, newer technologies offer performance improvements. However, 3G and 4G refer to the communication protocol between the mobile handset and the cell phone tower. So, it's only one piece of the puzzle. The throughput rate and browsing speed also depends on factors such as:

- How many cell phone towers are in the vicinity?
- How many users are sharing these towers?
- The bandwidth available to these cellphone towers to connect to the Internet or the carrier's network.

LAW ENFORCEMENT IMPACT

The advances in the mobile arena allow users to not just have access to information and services nationwide, but worldwide as well.

01010111 01101000 01100001 01110100 00100000 01101111 01101110 01100011 01100101 00100000 01110100 01110010 01100001 01110110 01100101 01101100 01100101 01100100 00100000 01101111 01110110 01100101 01110010 00100000 01110111 01101001 01110010 01100101 01110011 00101100 00100000 01101110 01101111 01110111 00100000 01110100 01110010 01100001 01110110 01100101 01101100 01110011 00100000 01110100 01101000 01110010 01101111 01110101 01100111 01101000 00100000 01110100 01101000 01100101 00100000 01100001 01101001 01110010 00101110 -David B. Smith, FBI

[4] http://www.diffen.com/difference/3G_vs_4G

7. OPERATOR'S DILEMMA! FEMTOCELL OR WI-FI?

INTRODUCTION

The growth of data centric devices is humongous and mobile data will roughly double each year from 2008 to 2013[1]

According to Cisco, the average broadband connection generates 11.4 Gigabytes (GB) of Internet traffic per month, or 375 Megabytes (MB) per day. Reports from early Fourth Generation (4G) Worldwide Interoperability for Microwave Access (WiMAX)-based broadband networks found that the average traffic per customer is analogous in Russia and the U.S., with 10GB of traffic per month.[2] Data projections for next decade anticipate that Internet traffic will grow at a compound annual rate of at least 50 percent. By 2020, the average mobile Internet connection from Third Generation (3G) and 4G handsets will generate 22.5GB of traffic, and Internet-centric devices will generate 171.7GB of traffic.

Data Growth in Internet-centric Devices (Laptops)

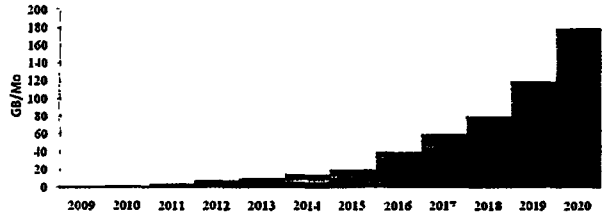


Figure 7-1 Data Growth in Internet-centric Devices[3]

The amount of traffic Internet will compel operators to offload data from their Macro Base station to indoor base stations. At least two solutions are on the table for operators: Femtocells and Wi-Fi offloads. Both approaches solve the backhaul issue by using customer or third-party links (e.g. DSL, MetroE, T1/E1, WISP, or others).

COST	
Macro BTS	High
Femto	Moderate
Wi-Fi AP	Low

Femtocells are tiny mobile cell sites that use the mobile operators' licensed spectrum supporting all devices and all services. Femtocells are a great way to extend coverage and create higher capacity. To extend data service in places where macro cell coverage is poor, a WiMAX Femtocell could be an ideal candidate. However, operators also have the option of extending indoor coverage through Wi-Fi access points. This article examines the various aspects of Femtocells and Wi-Fi for the purpose of indoor coverage.

ARCHITECTURE AND DEPLOYMENT

Femtocell-based architecture requires that all management and data traffic be passed through an Access Service Network Gateway (ASN-GW) and a security gateway to perform handovers and security procedures defined in IEEE 802.16e. Wi-Fi based systems do not require data traffic to pass through any central location and have a much flatter architecture than Femtocells. Of course, there are advantages to using a Serving Gateway (S-GW) and ASN-GW in the case of Femtocells.

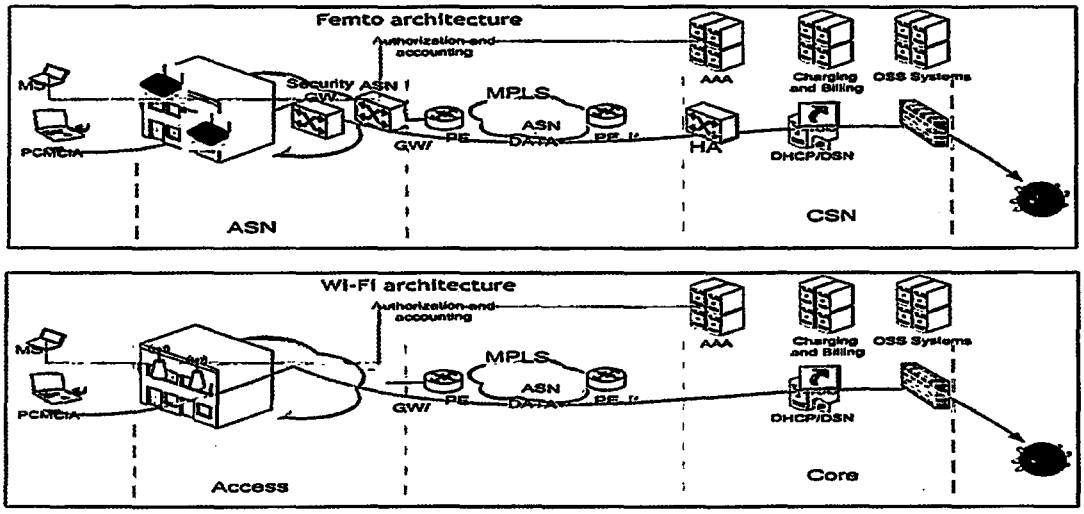


Figure 7-2 Femtocell vs. Wi-Fi Architecture

[1] https://www.cisco.com/en/US/netsol/ns827/networking_solutions_sub_solution.html
[2] http://img.en25.com/Web/WiMaxBroadbandSolutions/SenzaFili_YotaWP.pdf
[3] http://www.beyond4g.org/managing-data-networks

ECONOMICS

The current prices of femto access points are five to ten times higher than the cost of Wi-Fi devices. Businesses using operator controlled Femtocells will likely face economic challenges as a result of high prices, and retail customers may be deterred from buying Femtocells at current price levels. A huge demand for Femtocell access points is not expected in near future, therefore, it would be very difficult for operators to push Femtocell-based solutions to their customers. In fact, businesses using operator controlled Femtocells to provide higher capacity and coverage would face severe return on investment challenges as the cost of femto access points and the associated infrastructure is way too expensive compared to Wi-Fi access points.

SPECTRUM

The data growth expected in the next decade will keep operators hungry for spectrum. 83MHz of Wi-Fi spectrum in the 2.4GHz band is ideal for operators to manage the mobile data demand generated out of indoor locations. The next version of Wi-Fi, 802.11n, supports Multiple Input/Multiple Output (MIMO) and data rates up to 300Mbps. The cost of 11n devices is not significantly higher than 802.11b/g devices. Worldwide, operators are demanding at least 30MHz of spectrum for Broadband Wireless Access (BWA) application in the 2.3, 2.5, and 3.5 GHz bands. Current deployments are mostly in reuse, and there is little spectrum left for operators to build Femtocells. Free Wi-Fi spectrum in 2.4 GHz band will help operators provide sufficient capacity for indoor use.

DEVICES

The primary sources of mobile data demand are laptops, notebooks, and smartphones. Laptops and notebooks have Wi-Fi connectivity. Wi-Fi chipsets are prevalent and is included in almost 100% of the laptops and other Internet-centric devices on the market. Wi-Fi is already widely available and WiMAX-embedded devices may reach these levels in the next five to seven years. ABI research projects that 1 billion Wi-Fi chips will be shipped in 2011 and the global shipment of Wi-Fi enabled cell phones will double between 2009 and 2011. Wi-Fi is not only common in Internet-centric devices like laptops and notebooks. It is expected that 90% of smartphones will be embedded with Wi-Fi modules by 2014. Current Wi-Fi chipsets are very competitively priced and Intel has plans to embed WiMAX+Wi-Fi into their Mobile Internet Devices (MIDs) and all future Internet-centric devices.[4]

Intel is ready to ship 6250 Kilmer Peak chipsets, which will have 2×2 11 a/g/n and 16e WiMAX in the 2.3/2.5 and 3.5 GHz bands. The 11n version is capable of supporting peak data rates up to 300Mbps. Intel's next WiMAX module, Evans Peak, is targeted for MIDs and will support one module of 1X2 11 a/g/n, 16e, Bluetooth, and Global Positioning System (GPS) in the 2.3, 2.5, and 3.5 GHz bands.

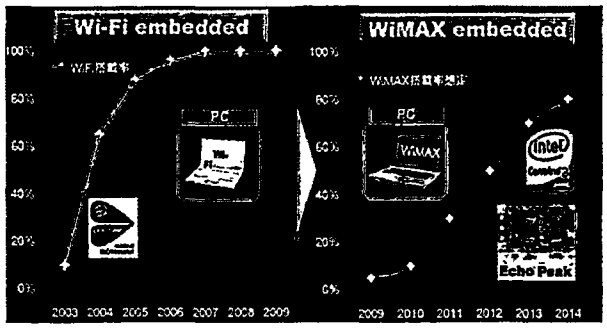


Figure 7-3 Wi-Fi vs WiMAX

ROADMAP

WiMAX release 1.5 will focus on a WiMAX/Wi-Fi/Bluetooth co-existence. A forum is also evaluating and addressing handovers between Wi-Fi and WiMAX.[5]

SUMMARY

Pico Base Station and Repeaters will continue to play an important role in extending coverage and generating additional capacity in wireless networks.[6] The economics of deploying Pico Base Stations in enterprise buildings and commercial hubs is encouraging. However, Femtocells appear challenging from a business and deployment perspective. There are numerous advantages associated with Wi-Fi for retail consumers and Wi-Fi will continue to complement wireless networks. WiMAX+WiFi router capabilities have already been demonstrated by Clearwire with its Clearspot, the Yota Egg, and UQ. Operators must keep Wi-Fi in their access strategy when building next generation mobile data networks.

"While this technology expands accessibility and productivity, it introduces complexity and security risks as wireless networks and handheld mobile devices become a new target for hackers and thieves."

~ Sarah Hicks, Vice President of Mobile and Wireless Solutions, Symantec

[4] http://www.beyond4g.org/intel-continues-its-commitment-to-worldwide-mobile-wimax-mids
[5] http://www.beyond4g.org/814
[6] http://www.beyond4g.org/overcoming-indoor-coverage-challenge-in-wimax

8. FCC'S POSITION ON BROADBAND WHITE SPACE

INTRODUCTION

Technology companies (e.g., Google, Motorola, Microsoft and Dell) have been lobbying the Federal Communications Commission (FCC) for years to open new spectrum to expand existing wireless services or create new wireless broadband services. For the last two years the FCC has been solicited by Congress to open the unused wireless spectrum that separates TV channels for use by unlicensed broadband networks. In November 2008, the FCC agreed to open up unused broadcast TV spectrum for unlicensed use, in the 300 Megahertz (MHz) to 400 MHz band of unused spectrum known as 'white space'.

BACKGROUND

"The FCC has been examining this issue for six years, and finished testing several proof-of-concept devices this summer to see if companies can develop products that use the buffer spectrum between licensed broadcast channels. The commission's Office of Engineering Technology (OET) found that sensing technology alone was not 100 percent effective in preventing channel interference. But when coupled with geo-location technology, which uses GPS technology along with a data base of known services using certain spectrum channels, interference was greatly reduced."[1]

In accordance with the rules, the FCC will require that all white space devices be tested and certified by the FCC Laboratory, as is required of all other wireless devices, including cell phones and wireless routers.

In early 2009, Congress directed the FCC to develop a National Broadband Plan to ensure every American has "access to broadband capability". Congress also required that this plan include a detailed strategy for achieving affordability and maximizing use of broadband to advance "consumer welfare, civic participation, public safety and homeland security, community development, health care delivery, energy independence and efficiency, education, employee training, private sector investment, entrepreneurial activity, job creation and economic growth, and other national purposes."[2]

Why is this significant? Why is this important to consumers? Why is this important to law enforcement (LE)?

"Like electricity a century ago, broadband communications is a foundation for economic growth, job creation, global competitiveness and a better way of life. It is enabling entire new industries and unlocking vast new possibilities for existing ones. It is changing how we educate children, deliver health care, manage energy, ensure public safety, engage government, and access, organize and disseminate knowledge."[3]

Under the Omnibus Broadband Initiative (OBI), the plan outlines four ways that the Government can influence the broadband ecosystem:

- Establish competition policies
- Ensure efficient allocation and use of Government-owned and Government-influenced assets
- Create incentives for universal availability and adoption of broadband
- Updating policies, setting standards, and aligning incentives to maximize use for national priorities

Long-Term Goals[4]

Goal No. 1: At least 100 million United States (U.S.) homes should have affordable access to actual download speeds of at least 100 Megabits per second and actual upload speeds of at least 50 Mbps.

Goal No. 2: The U.S. should lead the world in mobile innovation, with the fastest and most extensive wireless networks of any nation.

Goal No. 3: Every American should have affordable access to robust broadband service, and the means and skills to subscribe if they so choose.

Goal No. 4: Every American community should have affordable access to at least 1 Gigabit per second broadband service to anchor institutions such as schools, hospitals and government buildings.

Goal No. 5: To ensure the safety of the American people, every first responder should have access to a nationwide, wireless, interoperable broadband public safety network.

Goal No. 6: To ensure that America leads in the clean energy economy, every American should be able to use broadband to track and manage their real-time energy consumption.

[1] http://news.cnet.com/8301-1035_3-10082505-94.html
[2] http://www.broadband.gov/plan/executive-summary/
[3] Ibid
[4] http://www.broadband.gov/plan/executive-summary/

FCC Plan Opens 90 MHz of Satellite Spectrum[5]

The FCC wants to open mobile satellite spectrum in three bands for land-based services as part of its effort to free up an additional 500 Megahertz (MHz) of spectrum for mobile broadband.

The agency's proposed rulemaking would open a total of 90 MHz in the 2 Gigahertz (GHz) band, Big LEO band and L-band for uses other than satellite-based broadband services.

Specifically, the proposal aims to add co-primary fixed and mobile allocations to the 2 GHz band and expand existing secondary market policies and rules involving the use of satellite bands for terrestrial services. The FCC is also seeking comment on what actions the agency could take if the value of the spectrum increases.

CTIA President and CEO Steve Largent commended the FCC for opening up the spectrum. "We are pleased the Commission and the Obama Administration have joined us in recognizing the critical importance of harnessing our spectrum resources to benefit the nation's wireless consumers," he said in a statement.

GOOGLE-VERIZON NET NEUTRALITY DEAL

As of November 5, 2010, the FCC reported that, "The agency plans to cover the UHF and VHF television bands, experimental licenses, and ways to accelerate "opportunistic use" of underdeveloped spectrum. It doesn't plan to take up the issue of net neutrality or reclassifying broadband Internet services under Title II."[6]

b7E

LAW ENFORCEMENT IMPACT

The challenges facing LE increase with the introduction of each new wireless device. In fact, reports state that "wireless data traffic on the AT&T network has grown more than 5,000 percent over the past three years, largely attributed to today's advanced smartphones that are generating dramatically increasing volumes of network traffic."[7] "We're seeing advanced smartphones driving up to 10 times the amount of usage of other devices on average," according to Vice President and General Manager for AT&T Mobility and Consumer Markets in Minnesota."[8] Over 50 percent of homes have broadband connectivity. A smartphone device with Wi-Fi installed can automatically establish a dual connection while using the outdoor macro network for voice and mobile data services, and the indoor access point for mobile Internet traffic.

[redacted]

AUGMENTED REALITY[9]

Augmented reality (AR) has been discretely evolving for several years. Now, as a result of the fast-paced evolution of computing power and graphics capabilities, AR has matured into a technology that is expected to have a significant impact on the marketplace. "AR is a term for a live direct or indirect view of a physical, real-world environment whose elements are augmented by computer-generated sensory input, such as sound or graphics." Essentially, the technology works to enhance one's current perception of reality.

At the end of 2010, many major retailers and brands were releasing apps with AR capabilities because of the technology's ability to geotag products and locations. In 2011, the mobile AR trend is expected to see apps moving from simple wayfinding and local search to more robust experimental shopping tools that will bridge information in real-time and offer dynamic visualization.

AR applications are increasingly falling into two categories: those with trackers that put graphics into a scene, particularly for games, and those that are GPS-based which provides a user with information about their surrounding environment. Considered the younger, more successful brother to virtual reality, AR is a medium that's only just coming into its own through mobile applications like Word Lens and Google Goggles.

[5] http://www.wirelessweek.com/News/2010/07/Policy-and-Industry-FCC-Plan-90MHz-Satellite-Spectrum-Government/
[6] http://www.wirelessweek.com/News/2010/11/Policy-and-IndustryNet-NeutralityAbsent-FCC-Nov-Meeting-Legal/
[7] http://www.prnewswire.com/news-releases/att-investment-in-minnesota-network-aimed-at-enhancing-mobile-broadband-service-across-the-state-85340242.html
[8] Ibid
[9] http://www.businesswire.com/news/home/20101214005657/en/What%E2%80%99s-Store-Augmented-Reality-2011-Total-Immersion%E2%80%99s

9. CLOUD SERVICES

INTRODUCTION

With mass volumes of information being exchanged and viewed by individuals on all types of devices from smartphones to iPads; the demand and need for storage capacity has become a big business for some companies, but for those who subscribe or use these services it is important to select the right provider. In the past, companies in the technology, device and gadget industry strived to provide equipment that had the largest storage capacity and overall memory. Today, with the vast number of companies focusing on how to provide storage to both individuals and business, acquiring a service that meets your personal needs or your business model requirements is easy. As with any service provider there are guidelines and restrictions, along with risk and security issues. These services can be downloaded for free or a subscription can be purchased and utilized by the entire organization. Fees give value added services over free and basic services.

What's in the Cloud?

There are several types of cloud services. This article will discuss some of the most popular services and uses. As people acquire multiple digital devices, including tiny netbooks and super-smartphones, it becomes harder for them to coordinate all their documents, music and photos so, they have access from whichever device they're using at the moment.[1] Using these digital devices requires that the industry create a means for users to store and access the information. Ideally, it would be convenient to go to one location and retrieve all of the information, but sometimes that is not feasible due to the size and amount of information.

DriveHQ is an enterprise level online storage and backup provider. Although aimed at business users, DriveHQ also targets individuals with its free memberships and low cost subscription options. The service is professional and high quality but still easy enough to use for novice users. It offers many different services bundled into one package - online storage, online backup, File Transfer Protocol (FTP) server hosting and email server hosting.

The online storage service can be accessed through the downloadable desktop client, a Web-based interface, or an FTP client of your choice, although the desktop software is only available for Windows. Mac or Linux users only have the Web-based or FTP client options. Drive HQ's proprietary software for uploading files provides robust functionality for uploading large files. It also lets the user automatically back up files to online space either on demand or at scheduled intervals.

Security for business level service appears to be well implemented and thorough. All uploads are handled using 128-bit SSL encryption, which is a current standard. Files can also be stored in encrypted form so that not even the data center managers can view them. This is very important when dealing with what may be critical business documents and sensitive information. The free option offers 1 Gigabyte (1GB) of storage space and 200 Mb of downloads per month, but you can only get a free account if you sign up and use the DriveHQ software.[2]

Dropbox is basically an intelligent combination of Box.net, dot.mac, and Microsoft's FolderShare syncing service. It makes online storage and sharing of files simple – as simple as dragging files into specially marked local folders. Files are constantly being uploaded and downloaded to edit, and therefore requires some additional peer-to-peer software. Dropbox is available via a public beta for GigaOM readers."[3]

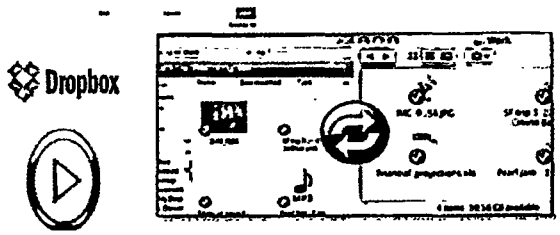


Figure 9-1 Main Screen and Work Area

The software, once downloaded, is simple to install (it works on both Windows and Mac) and integrates with the file browser. It runs efficiently in the background. You create folders inside the DropBox folder and then just drag and drop them. The files are constantly synced with your online storage locker – any time a file is changed, the changes are sent to the online folders, which can be accessed via any Web browser even if your home machine is shut off. The system keeps revised versions of the files as backup, just in case the user accidentally erases or damages the "live" version of a document. Therefore, there is a file timeline that may be used to identify changes and dates. You can click and share the "URLs" of every file with anyone by simply sending them an email (a feature that opens up viral growth opportunities for DropBox).[4]

[1] http://online.wsj.com/article/NA_WSJ_PUB:SB10001424052748704107104574572002476586722.html
[2] http://online-storage.no1reviews.com/drivehq.html
[3] http://en.wikipedia.org/wiki/GigaOM
[4] http://gigaom.com/2008/03/11/drop-it-like-its-drop-box/

At the very least, you can use Dropbox to automatically backup a subset of your files, and to access them when traveling. You can also use the service to easily share files with friends and associates. However, the service does not currently provide 'any' password protection on files or folders to limit public access. While Dropbox appears to be just another cloud storage service, it's actually a file synchronization service that will sync your files, remotely back them up and provide web and iPhone access at the same time.

Are images encrypted? "Dropbox stores their data on Amazon S3 using AES-256 encryption. Dropbox employees don't have access to your data, and all traffic between your computer and their servers is encrypted using SSL."[5]

The encryption software that will allow you to secure your Dropbox is called "EncFS".. It works by creating a folder in which to store an encrypted version of each of your files and folders, and then making the unencrypted names and content available in a different folder.

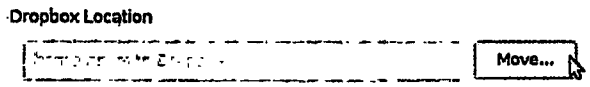


Figure 9-2 Dropbox Location

Can files be stored only on the cloud file server and not on the computer? The cloud serves to keep your files up to date, but Dropbox uses a hosted virtual disk on your computer to store files.

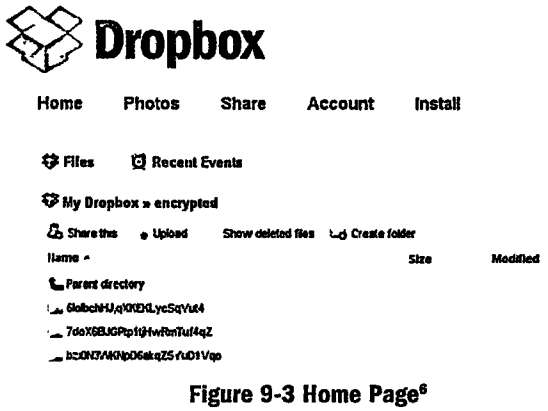


Figure 9-3 Home Page[6]

What information on the local PC points to the cloud (e.g. client server)? Dropbox uses the drag and drop concept to move files from one location to another and creates a Dropbox folder on your hard drive which syncs with the Dropbox server on the Internet.[7]

Dropbox, in a number of ways, goes beyond FolderShare's simple ease of use. You can access your files through the Web browser in addition to the desktop client. All files are version controlled so you can revert to an earlier version of a document, or restore it completely when lost. There are also two special folders within the local Dropbox folder: one for publicly sharing files (via distinct URL) and one for sharing photos (which gets distinct URLs for particular galleries that have been formatted online for easy viewing).[8]

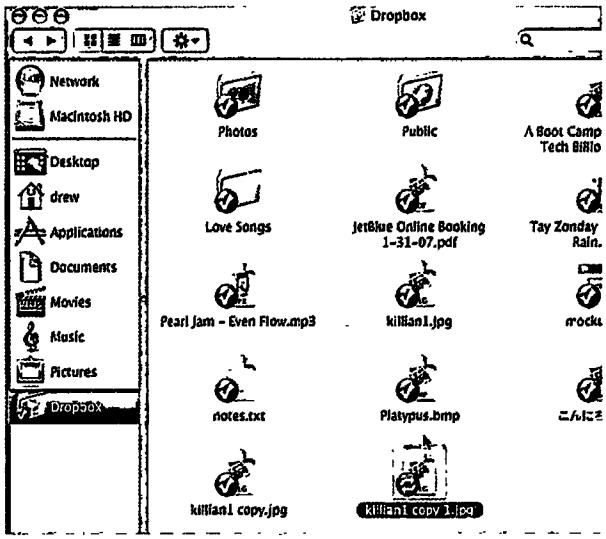


Figure 9-4 Screenshot of File Library

FolderShare provides a desktop client that syncs local folders across computers. But it's a bit like comparing Vista to MacOS; both get the job done, but one may be easy to use and appears designed for maximum customer satisfaction. FolderShare allows a private peer-to-peer network to be created that will help you to synchronize files across multiple devices and access or share files with colleagues and friends. The user no longer needs to send large files via email, burn them to CDs/DVDs and mail them, or upload them to a website. It allows the user to share and sync important information instantly with anyone who is invited, making it a good solution for file sharing.[9]

"Our industry is going through quite a wave of innovation and it's being powered by a phenomenon which is referred to as the cloud."

~ Steve Ballmer, CEO, Microsoft

[5] http://www.sidelane.co.uk/blog/2009/12/locking-down-your-dropbox-with-espionage/
[6] http://pragmattica.wordpress.com/2009/05/10/encrypting-your-dropbox-seamlessly-and-automatically/
[7] http://www.bloggersbase.com/internet/dropbox-puts-the-drag-n-drop-into-online-collaboration/
[8] http://gigaom.com/2008/03/11/drop-it-like-its-drop-box/
[9] http://fileforum.betanews.com/detail/FolderShare-/1055803293/1

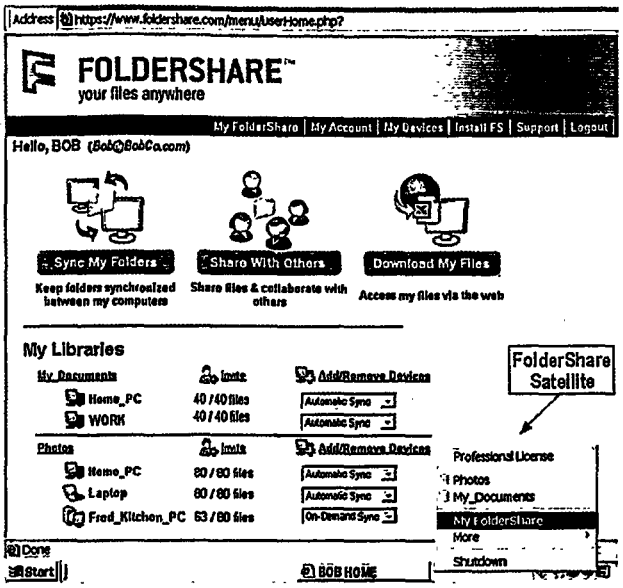


Figure 9-5 FolderShare

From the creators of BOXSTr, a file-hosting and backup solution comes a new cloud-based storage solution, called OpenDrive. Presently in public beta mode, OpenDrive acts much like a typical redundancy device, but its downloadable software utility connects the users personal information to the Web more fluidly, with an especially smart syncing feature.[10]

OpenDrive recognizes which files are stored on a user's local machine and also with online accounts, and when edits are made on the user's local hard disk and subsequently saved, those changes can be registered automatically via OpenDrive.

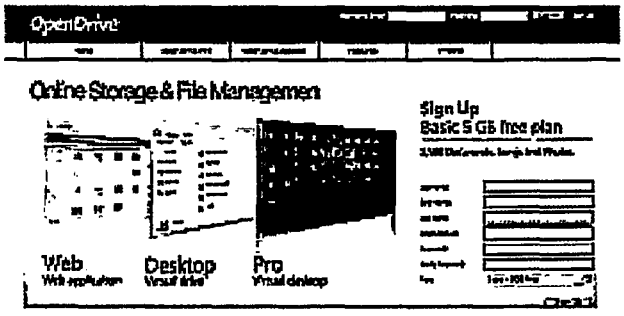


Figure 9-6 OpenDrive Log-on

OpenDrive advertises a free storage limit of 1 GB, which is considerably less than the amount offered by BOXSTr. But as an added plus if a user is already registered with BOXSTr, then registration with OpenDrive is not necessary. OpenDrive also manages data via the Web through BOXSTr and it is only available for Windows XP or Vista users.

SPIDEROAK

SpiderOak is an online backup, syncing and sharing service similar to Dropbox or SugarSync. It is powerful, versatile and free to use for up to two GB of storage.[11] SpiderOak is a strong competitor in the arena of apps that backup, share and sync your data across multiple machines. Once signed on, users see the menu bar application with several tabs to select from:

- Status – (Schedule Backups) Back Up View Sync Share

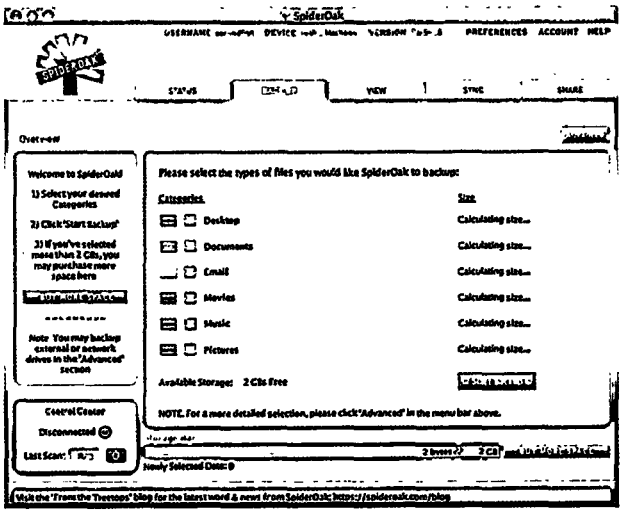


Figure 9-7 SpiderOak Menu Application

There are two basic pricing plans for SpiderOak: the Free Account and the Plus Account. The Free Account gives access to all of the features and is only limited in the capacity or storage you receive, which is up to 2 GB. The Plus Account is $10 per month for every 100 GB increment. If a user wants 300 GB of storage, it is $30 per month. Alternatively, if users choose to sign up for a year, the rate is lower: $100 per year for every 100 GB increment. So, if 300 GB is purchased on a month-to-month basis it would cost $360 per year, but if the user signs up for a year it would only cost $300.

SUGARSYNC[12]

There is another client application that has been compared to SpiderOak and Dropbox called SugarSync. SugarSync is an interface for Windows, which integrates with Explorer to show the status of the synced folders with small colored indicators overlaid on the file/folder icons. SugarSync offers

[10] http://mashable.com/2008/07/15/opendrive/
[11] http://mac.appstorm.net/how-to/utilities-how-to/how-to-back-up-your-data-with-spideroak/
[12] http://technologykills.com/2010/04/06/sugarsync-vs-spideroak/

clients for Windows, Mac, iPhone, Android, Blackberry, and Windows Mobile, but there are no provisions for other operating systems, such as Linux.

SugarSync implements share administration in the main Web interface that is highly polished with similar features to SpiderOak. Files are transferred one at a time, at a high data rate. It supports file versioning, keeps deleted items until permanently removed while monitoring the file system for changes and automatically uploads. SugarSync doesn't require the user to be online to use the files it synchronizes. It offers a Web Archive to store files without syncing them to a specific device. There is also file sharing and files can be e-mailed to a SugarSync account. SugarSync data is SSL-secured, and encrypted once it hits the servers. Data is stored in "geo-redundant, world class data centers." The service offers 2 GB of free storage, allows use of all features, supports multiple devices, and syncs and share files up to the 2 GB limit. 30 GB from SugarSync costs $5 per month, which is easily affordable.

ZUMODRIVE

ZumoDrive provides the convenience of home information away from home by allowing the user to put any amount of media from Macs or PCs to a phone. Users can read all file types to include Word, Excel, PowerPoint, and PDF, anywhere and anytime. It offers one of the better media capabilities out of all "cloud apps". ZumoDrive is not a stand-alone application; it works with a free PC, Mac, and Linux app that you can download from zumodrive.com. Get 2 GB of storage for free and everything put on ZumoDrive is protected with encryption and stored on file servers.

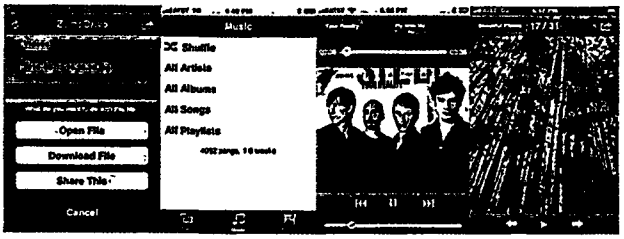


Figure 9-8 ZumoDrive Main Screen[13]

Citrix 'GoToMeeting'

Citrix recently announced the availability of a new Apple iPad app called Citrix GoToMeeting®. Launched as a free app for download through Apple's App Store, "The Citrix GoToMeeting App for iPad brings the same level of simplicity to the world of business meetings, making it easy for iPad owners to collaborate from anywhere via online meetings that are both effortless and visually stunning."[14]

Citrix boasts that GoToMeeting, "...is the easiest and most cost-effective way to conduct an online meeting."[15] Specifically, the GoToMeeting app for iPad allows users to:

- Collaborate with remote colleagues in real-time
- Present to remote audiences
- Demonstrate products to prospects and customers
- Train customers and employees across the globe[16]

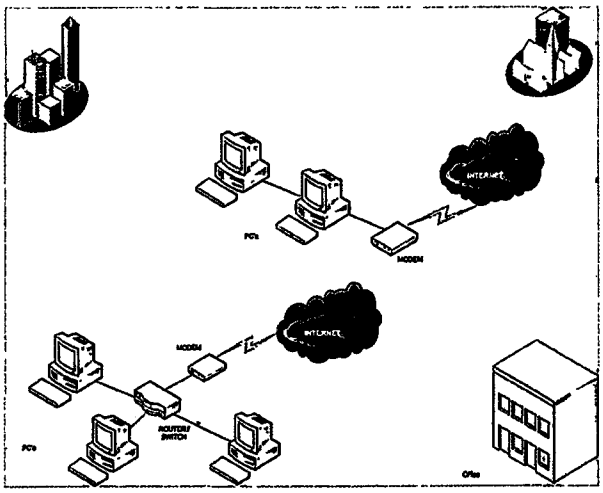


Figure 9-9 Citrix GoToMeeting

Citrix has also developed a GoToMeeting Corporate app, which is designed to provide online meeting services for multiple users. The GoToMeeting Corporate app for iPad includes unlimited online meetings as well as, "... features to make it easy for you to manage multiple users, streamline usage, and maximize your cost savings."[17] Additional GoToMeeting Corporate features include an:

- **Administration Center:** Quickly deploy GoToMeeting to new users, control feature access and track usage from a convenient online Administration Center
- **Meet Now Buttons:** Start meetings from the company's own website
- **XenApp Integration:** Integrate GoToMeeting into the XenApp® environment
- **Integrated Toll-Free Audio Service:** Purchase convenient toll-free packages from Citrix Online Audio[18]

GoToMeeting for Individuals provides an alternative online solution for the face-to-face meeting, which may require

[13] http://itunes.apple.com/us/app/zumodrive/id292504894?mt=8
[14] http://www.citrix.com/English/NE/news/news.asp?newsID=1864354
[15] http://www.citrix.com/english/ps2/products/product.asp?contentid=13976
[16, 17, 18] Ibid

business travel and is:

- **Easy to use.** The streamlined interface makes it extremely easy for organizers and meeting attendees to start meeting right away on both PCs and Mac® computers.
- **Cost-effective.** GoToMeeting's All You Can Meet® subscription model provides unlimited meetings for one flat fee, with no limits on meeting duration and no "overage" charges. Plus, VoIP and toll-based phone options reduce audio costs even further.
- **Secure.** GoToMeeting uses industry-standard SSL and U.S. government-standard 128-bit AES encryption to ensure that confidential meeting information remains private. Security is built-in and no configuration is required by users or administrators.[19] The following figures display how to host a GoToMeeting.

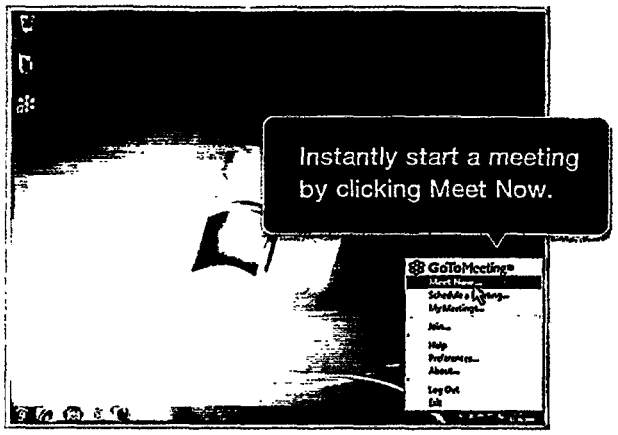


Figure 9-10 Host Starts GoToMeeting[20]

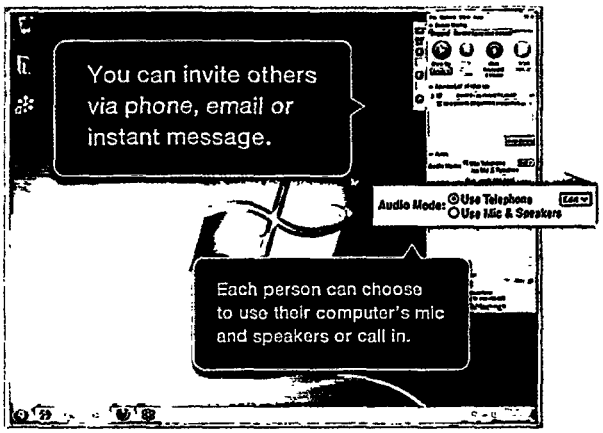


Figure 9-11 Host Invites Meeting Attendees[21]

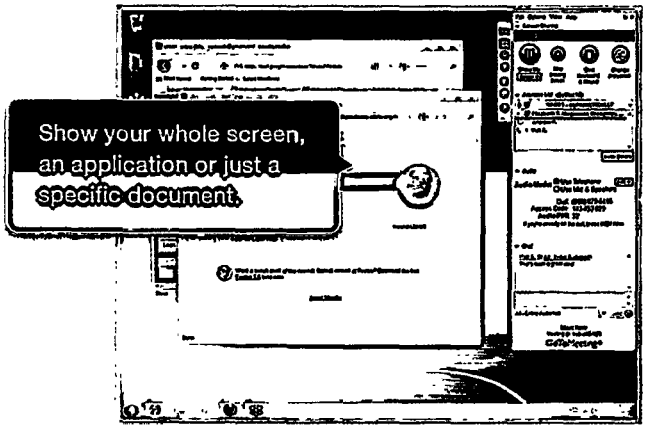


Figure 9-12 Host Shares Screen/Documents[22]

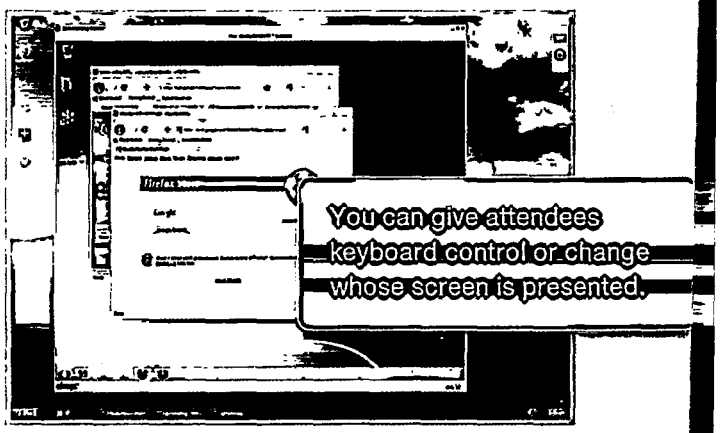


Figure 9-13 Attendees See Shared Screen[23]

GoToMeeting is a hosted service, delivered via Web browsers, downloadable client executables and a network of multicast communication servers operated by Citrix Online. It has the following security features:

- **Powerful encryption:** All GoToMeeting data is encrypted with industry-standard SSL and U.S. government-standard 128-bit AES encryption, including screen-sharing data, keyboard and mouse data, and chat messages.
- **Privacy:** Meeting information is only available to the organizer and invited participants.

[19, 20, 21, 22, 23] Ibid

- **Authentication and password security:** Strong passwords, unique meeting IDs and optional meeting passwords protect privacy and integrity. Through attendee authentication, GoToMeeting ensures that only authorized attendees can join meetings to which they have been invited.
- **Firewall and network compatibility:** Administrators don't need to reconfigure firewall ports, which could potentially compromise security.
- **Role-based security:** Organizers set the appropriate controls and rights based on user roles.
- **Endpoint system security:** GoToMeeting creates a secure endpoint on each user's desktop with Web-downloadable executables that employ strong cryptographic measures.

b7E

LAW ENFORCEMENT IMPACT

With the growth of cloud computing, the major challenges are not posed by the technology tool anymore, [redacted] Cloud computing is evolutionary from a technology standpoint [redacted] in that with the rapid development of services, identifying and assessing the protocols to deal with this type of storage [redacted]

GOOGLE OVER IPV6[24]

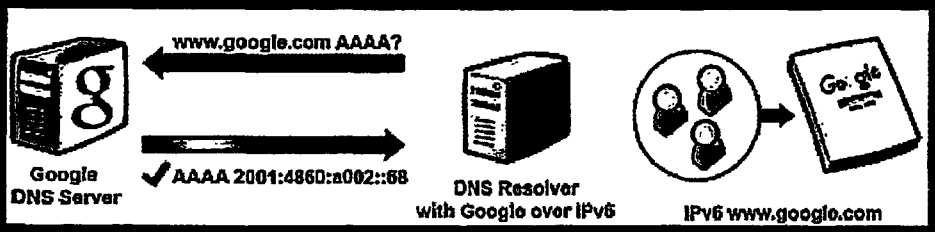
At Google, we believe that IPv6 is essential to the continued health and openness of the Internet - and that by allowing all devices on a network to talk to each other directly, IPv6 will enable innovation and allow the Internet's continued growth. Typical Google users do not need to do anything to prepare for IPv6, but we are working with network operators to support the transition.

In March 2008, we began offering Google search over IPv6 on IPv6-only websites like ipv6.google.com (IPv6 connection required), but other Google products were not generally available over IPv6.

That's why we created Google over IPv6. If you operate a network that supports IPv6, we may be able to enable Google over IPv6, letting you give users seamless access to most Google services over IPv6 simply by going to the same websites they usually use, such as www.google.com.

How it works

Google over IPv6 uses the IPv4 address of your DNS resolver to determine whether a network is IPv6-capable. If you enable Google over IPv6 for your resolver, IPv6 users of that resolver will receive AAAA records for IPv6-enabled Google services.



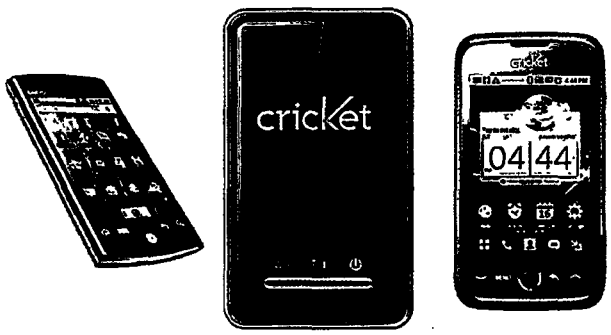
Normally, if a DNS resolver requests an IPv6 address for a Google website, it will not receive one, but a DNS resolver with Google over IPv6 will receive an IPv6 address, and its users will be able to connect to Google websites using IPv6.

[24] http://www.google.com/intl/en/ipv6/

10. WIRED VS. WIRELESS

BACKGROUND

"While the United States was built on the postpaid model (and relies heavily on consumers' use of credit) Europe's wireless industry has long thrived on the prepaid model, with less credit-dependent customers willing to shell out a little extra to get a premium device without having to sign a contract. As differentiation between postpaid and prepaid fades, more Americans will start to lean towards adopting the European way when it comes to cell service. The prepaid proposition has always been burdened with the 'you-get-what-you-pay-for' stigma. But that's changing as the smartphone playing field levels and device and data prices drop dramatically".[1]



INTRODUCTION

"Wireless technology is becoming increasingly popular. It has been said that wireless networks will possibly become more widely used than the wired networks".[2]

With the booming demand for mobile access to multiple applications and services, the evolution and proliferation of Wireless Local Area Network devices and applications have outpaced the ability to scale networks efficiently. In fact, the prediction is that "70% of new enterprise users by 2013 will be wireless by default and wired by exception".[3]

During the first wave of the wireless revolution, being out of the office didn't mean being out of action. BlackBerrys, iPhones, and 3G dongles for laptops let people stay connected on the move.

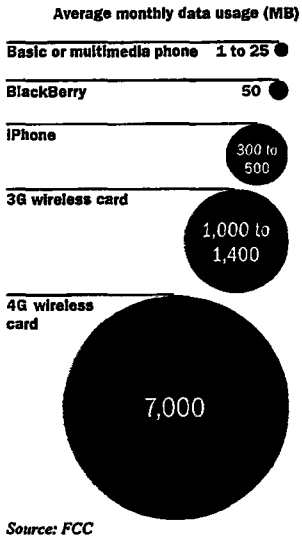
The second wave, ushered in by the development of 4G mobile broadband, will take the mobile revolution indoors. Although consumer excitement over apps and smartphones is high, and has attracted much of the attention of the press, the enterprise will be the first serious consumer of 4G services. Cellular networks and other service providers are preparing services that will potentially elimate the need for wired infrastructure such as desk phones and wired Internet links.

The rollout of Verizon's Long Term Evolution (LTE) service sets the standard for future networks; it's due to launch at the end of 2010 and will bring coverage to more than 100 million people. "We'll be announcing 4G modems first and support for cell phones by mid-2011."[4] The firm isn't building a cell-phone network but a data network, one just as fast as wired links. Sprint Nextel has been rolling out its 4G service in major U.S. cities all year, and is now up to 55 cities. That network is based on the WiMAX standard, an alternative to LTE. Sprint is also working on the idea of packaging a set of 4G modems and other hardware into an off-the-shelf 'office in a box'. "It would contain everything you need to set up a new branch and connect it up."

There are doubts that networks can keep pace with the demand for wireless data, a demand that's growing 55 percent annually in North America. Predictions indicate that by 2013, there will be more North Americans connecting to the Internet via mobile broadband than via any other form of access—with enterprises expected to account for much of the demand.

INCREASING APPETITE

The capabilities of new devices inspire users to download more and more data.



Source: FCC

Figure 10-1 Monthly Data Usage

The era of flat pricing for wireless data looks to be ending and the next step might involve asking customers to pay for different tiers of service depending on their data demands. Ultimately, the net neutrality policy may become the biggest practical distinction between wired and wireless connections.

LAW ENFORCEMENT IMPACT

[redacted]

[redacted]

[1,2] http://www.lehman.edu/itr/wireless-network.php
[3] http://resources.idgenterprise.com/original/AST-0008746_Gartner_Newsletter_Aug.pdf
[4] http://technologyreview.com/printer_friendly_article.aspx?id=26636

11. BRIDGING THE GAP: WI-FI HOTSPOTS

INTRODUCTION

With the various wireless technologies that are available today, people are able to conduct business, keep in touch with family, or simply spend a few minutes checking e-mails or social networking websites all while on the go. Over the years, the popularity of wireless devices such as laptops, netbooks, notebooks, smartphones, MP3 players, and e-readers have facilitated the development of a "constantly connected" culture that continues to expand everyday.

Although there are considerably more ways and places to connect to the Web than there were a decade ago, for some, publicly offered Wi-Fi hotspots are not enough. This growing desire among consumers to have access to the Internet wherever they go has led to an increase in the number of businesses offering free 802.11 Wi-Fi including hotels and resorts, airports, popular coffeehouses, bus stations, and public libraries. For users that want to connect to the Web in areas where Wi-Fi is unavailable, or do not want to pay fees that may be charged for commercially provided Wi-Fi, there is the mobile hotspot. With a mobile hotspot device, a user no longer has to worry about how and where they will be able to connect to the Internet. With increasingly popular mobile hotspots, users now have the ability to create a personal Wi-Fi hotspot with the convenience of having the Internet available anytime, anywhere, with access to a wireless cellular network.

Mobile hotspots are not becoming more attractive to buyers solely because they are portable. They also offer a single point of access for all of a user's wireless devices. Equally appealing is the mobile hotspot's ability to be shared among multiple users, allowing several people to benefit from Internet connectivity while only using one access interface. There are many options available for people interested in investing in a mobile hotspot. Today, "You can buy a simple, slim unit that fits in a pocket or others that maximize throughput by shifting from 3G to speedier 4G networks." Additionally, "You can convert some cell phones into hotspots, while a few new phones now come with hotspots included."

WI-FI PERSONAL AREA NETWORKS

Wi-Fi Personal Area Networks (PANs) are setup and managed by a specific user, unlike corporate Wi-Fi networks that are established and administered by a corporate network administrator. Once arranged, a limited number of Wi-Fi devices can connect to the Wi-Fi PAN in order to share various resources and internet access. In contrast to fixed and complicated corporate Wi-Fi networks, Wi-Fi PANs are easy to use and can be setup with little effort in any location. As an added benefit, Wi-Fi PANs provide users with the same bandwidth and range as a corporate Wi-Fi network, which is typically larger than conventional wireless PAN technologies like Bluetooth and Infrared.

The advantages of Wi-Fi over more conventional short range wireless technologies has resulted in the development of more devices equipped with Wi-Fi that can be easily integrated into a Wi-Fi PAN. Once integrated, devices including: digital cameras, digital projectors, printers, game consoles, HDTV, and digital photo frames can share resources at high data rates and across relatively long distances, wirelessly.

The potential benefits of using a Wi-Fi PAN include:

- Sharing of Internet/Network access with other Wi-Fi users and Wi-Fi devices
- Sharing of data directly between two or more Wi-Fi users
- Enjoying content accessible on the user notebook (such as YouTube) on a HDTV wirelessly
- Transfer of pictures/video from a digital camera/digital camcorder directly to computer instantaneously over the air within the range of Wi-Fi PAN
- Printing of user's documents on the printer over the air
- Projection of user's content wirelessly through a projector[1]

Today, smartphones and personal mobile Wi-Fi hotspot devices are used to set-up Wi-Fi PANs, which allows users to create open or closed private networks.

TYPES OF MOBILE HOTSPOT DEVICES

The following mobile hotspot devices are examples of popular portable Wi-Fi products available to the public.

Novatel MiFi 2200

MiFi is a line of compact wireless routers that serve as mobile Wi-Fi hotspots. Through backconnections to a cellular data network, and frontconnections to local Wi-Fi devices (up to 10 meters/30 feet distance), MiFi creates a local area of shared high-speed Internet connectivity.[2]

[1] http://www.informationweek.in/Software/10-04-27/WI-FI_personal_area_networks_get_a_boost_with_Windows_7.aspx
[2] http://en.wikipedia.org/wiki/MiFi

The Novatel MiFi 2200 acts as a mobile Wi-Fi hotspot that has no screen and is powered on by a single button.[3] Measuring at 3.5"x 2.3"x 0.4" and weighing approximately 2.0 ounces, the Novatel MiFi 2200 is too large to fit in a typical wallet, but it is small enough to be considered pocket-sized. The MiFi 2200 creates a Wi-Fi hotspot using a 3G connection that can be shared among five devices.[4] Like a cell phone, the Novatel MiFi wirelessly connects to a 3G cellular network, but unlike a phone, the device broadcasts a Wi-Fi signal to its surrounding area. This capability allows devices within a 30-foot range to connect to the Internet.

Figure 11-1 Verizon Wireless Novatel MiFi 2200[5]

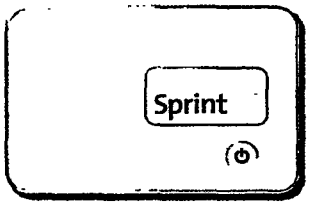


Figure 11-2 Sprint Novatel MiFi 2200[6]

Overdrive 3G/4G

The Overdrive 3G/4G, available from Sprint for $49.99 is another mobile hotspot option that is small enough to fit in your pocket. Although slightly bigger than the Novatel MiFi 2200, the Overdrive 3G/4G includes more features such as the ability to connect to Sprint's 3G network as well as the faster 4G network, where available. Other features include, "...a bright screen that displays information like remaining battery life, signal strength, the hotspot's name, password and the number of connected devices."

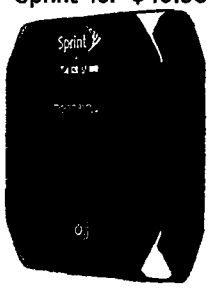


Figure 11-3 Sprint Overdrive 3G/4G[7]

Clearwire Clear Spot

Clearwire's Clear Spot uses Sprint's 4G network to provide linternet connectivity. Larger than the Overdrive 3G/4G, the Clear Spot is not ideal for users wanting a pocket-sized device. The Clear Spot costs $49.99 and requires a modem ranging in price from $69.99 to $224.99, depending on desired features.

Figure 11-4 Clearwire Clear Spot[8]

The Clear Spot offers Wi-Fi connectivity to Sprint's 4G network, that is not currently available, nationally. The Clear Spot can support up to eight wireless devices within a 150 foot range. Plans are available that offer 3G speeds and unlimited 4G access.[9]

CradlePoint PHS300

The CradlePoint PHS300, "...is a compact router device which connects to a user's laptop to create a Wi-Fi hotspot for up to 16 users." The self managing device is battery powered and can connect several users to a 3G/4G network by simply inserting a wireless broadband card into a laptop. One of the CradlePoint PHS300's most important and unique features is the capability to support up to five broadband cards at the same time, regardless of the user's carrier or the services used. The CradlePoint PHS300's ports are load balanced and can be used to increase bandwidth and provide Wi-Fi service up to 150 feet.[11]

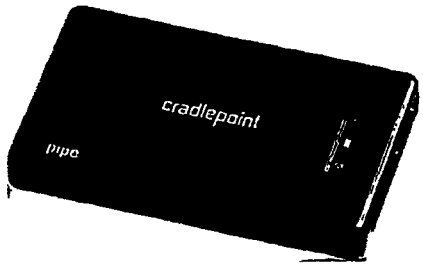


Figure 11-5 Cradlepoint PHS300[10]

CLEAR iSpot

The iSpot, made by CLEAR, is a mobile hotspot device designed specifically for use with Apple's iPad, iPhone, and iPod. iSpot allows up to eight Wi-Fi enabled devices to connect to the Internet in areas where CLEAR provides 4G coverage. The password protected iSpot is small enough to fit in your pocket and has a rechargeable battery that provides up to four hours of continuous use. In comparison to many of the other mobile hotspot devices on the market, it is relatively inexpensive and offers an unlimited 4G data plan.[12]

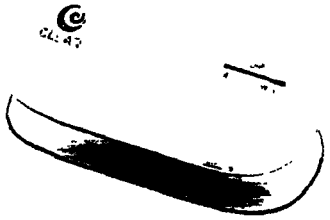


Figure 11-6 CLEAR iSpot[13]

Vodafone Mobile Wi-Fi R201

Vodafone recently launched the Mobile Wi-Fi R201. This mobile hotspot device, which connects automatically once the user enters the Wi-Fi authentication key, supports the

[3] http://www.nytimes.com/2010/06/03/technology/personaltech/03basics.html?src=busin
[4] http://www.networkworld.com/community/node/66583
[5] http://www.quantum-wireless.com/store/media/catalog/product/cache/1/image/500x500/9df78eab33525d08d6e5fb8d27136e95/m/i/mifi-2200.jpg
[6] http://ecx.images-amazon.com/images/I/41UYWRBTteL.jpg
[7] http://www.ubergizmo.com/photos/2010/1/sprint-overdrive.jpg
[8] http://cdn.slashgear.com/wp-content/uploads/2009/04/clearwire_clear_spot_personal_hotspot-480x295.jpg
[9] http://www.nytimes.com/2010/06/03/technology/personaltech/03basics.html?_r=1&src=busin
[10] http://posterous.com/getfile/files.posterous.com/temp-2010-04-20/IFloyjgJqJlnxdwhmutGqxFDlxarrbpwBvFjUbczJDfjlcxHECncHtHCizj/CradlePoint_PHS300.jpg.scaled1000.jpg
[11] http://business-solutions.tmcnet.com/topics/business-solutions/articles/87790-cradlepoints-phs300-personal-wifi-hotspot-supports-up-16.htm
[12] http://www.trendygadget.com/wp-content/uploads/2010/08/ispot.jpg
[13] http://www.clear.com/spot/ispot

Digital Living Network Alliance (DLNA) standard, which allows DLNA-compatible devices to share digital content among each other. The Vodafone Mobile Wi-Fi R201 is the first mobile router to be deemed compatible with Windows 7. The device is approximately the size of a credit card and creates an instant mobile hotspot for up to five wireless devices. Currently, Mobile Wi-Fi R201 is only available in countries where Vodafone operates, which does not include the U.S.[15]

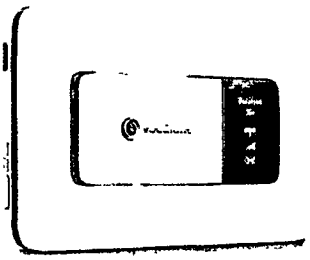


Figure 11-7 Vodafone Wi-Fi R201[14]

CELL PHONES AS MOBILE HOTSPOTS

One of the most novel ways for a user to create a mobile hotspot is through the use of a cell phone. Using a smartphone as a mobile hotspot can help eliminate clutter by allowing the user to limit the number of devices that must be transported. Phones that offer this capability include Verizon's Palm Pre Plus, which is available for $49.99 with two-year contract. The Verizon Pixi Plus is free with a two-year contract and includes the mobile hotspot option. Using a cell phone as a mobile hotspot provides the same type of internet connectivity as other mobile Wi-Fi devices, although, this function is likely to drain a smartphone battery quicker than normal.

Sprint's HTC EVO 4G, which runs on the Sprint 4G network, also has mobile hotspot support. The mobile hotspot feature on the HTC EVO 4G device is available for $29.99 in addition to the Sprint calling and data plan. AT&T is also allowing tethering for the iPhone to a computer for a monthly fee.[16] Google's updated Android 2.2 operating system includes a hotspot feature that allows some Android phone models to be turned into a mobile Wi-Fi hotspot without requiring a USB cable.[17]

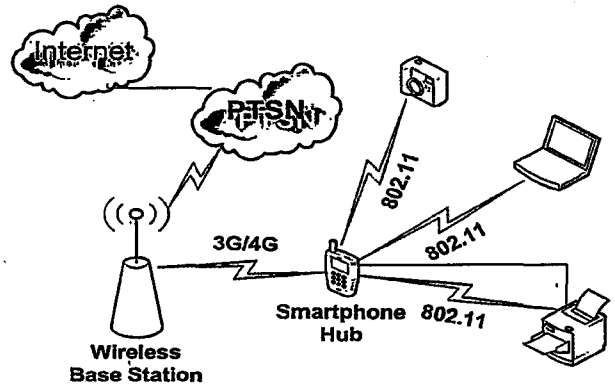


Figure 11-8 Mobile Wi-Fi Hotspot Network Using a Smartphone

For users that own cell phones without built in mobile hotspot capabilities, there is software available that can transform many cell phones into mobile hotspots. The WMWifiRouter software, which was created by Morose Media in the Netherlands, works with a variety of cell phones. In order to turn a cell phone into a mobile hotspot, a user can download the WMWifiRouter software directly to the phone from the http://wmwifirouter.com/ website for $19.99.

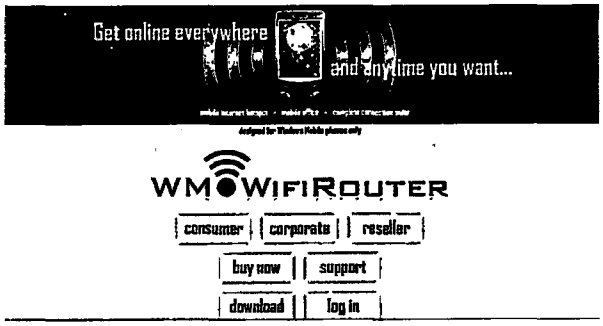


Figure 11-9 Screenshot of WM WiFi Router Homepage[18]

A 21-day trial version of the software can be downloaded for free. In order to use the WMWifiRouter software, the user must have:

- Windows Mobile 5: AKU 3.3 or newer
- Windows Mobile 6: 6.0, 6.1, 6.5 or 6.5.3
- Both a Wi-Fi and a cellular data connection
- An installed and working version of Internet Sharing

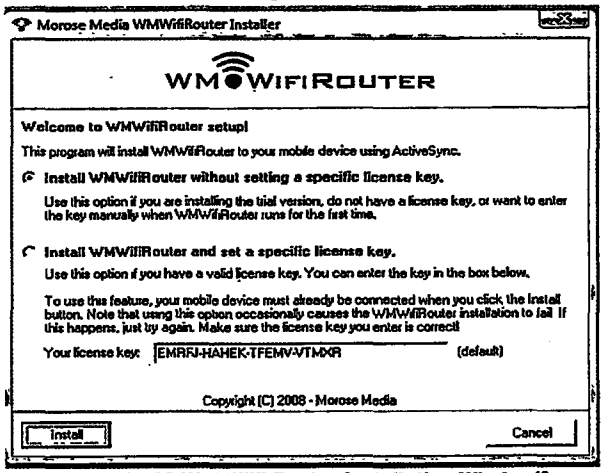


Figure 11-10 WM WiFi Router Installation Window[19]

[14] http://www.crunchdot.com/wp-content/uploads/2010/08/153547ee18162010.jpg.jpg
[15] http://www.networkworld.com/community/node/66583
[16] http://www.nytimes.com/2010/06/03/technology/personaltech/03basics.html?_r=1&src=busln
[17] http://blogs.computerworld.com/16153/seven_reasons_android_2_2_froyo_beats_the_iphone
[18] http://global.wmwifirouter.com/
[19] http://global.wmwifirouter.com/consumer/

The JoikuSpot, available at joikushop.com, supports many phones that use the Symbian operating system including several Nokia and Samsung models. Smartphones such as the iPhone and some Android phones can be hacked to operate as mobile hotspots, as well. Multiple methods can be used to root an Android phone to allow tethering. They include:

- Tether Android with Apps that Need Root (Free, heavy configuration)
- Tether Android with Proxoid (Free, no root required, some configuration)
- Tether Android with PDAnet ($30, no root required, minimal configuration)

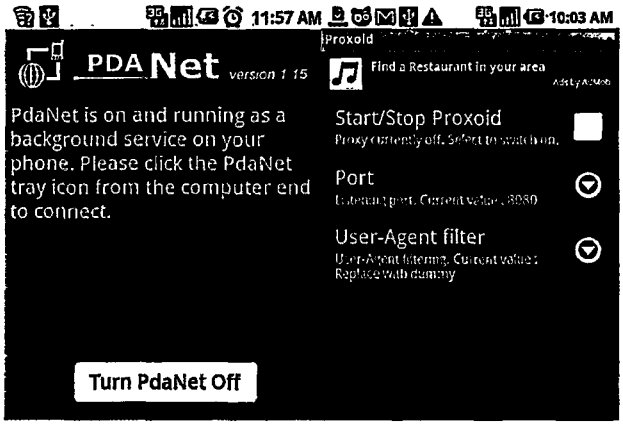


Figure 11-11 PdaNet Tethering App

Figure 11-12 Proxoid Tethering App

For more details on how to root an Android phone and install tethering apps such as PdaNet and Proxoid that allow an Android phone to operate as a mobile hotspot, visit the following webpage: http://lifehacker.com/5447347/how-to-tether-your-android-phone.[20]

MyWi Mobile Hotspot App

Once an iPhone has been jailbroken, it can be turned into Wi-Fi hotspot by downloading the MyWi app. MyWi is a jailbreak app that allows a user to tether and create a Wi-Fi hotspot on their iPhone.[21] The MyWi app costs $9.99 to download, and users must pay a fee to use the service after the trial period expires. To turn an iPhone into a mobile hotspot, a user would first need to jailbreak their iPhone. Once the phone has been jailbroken, the user can then follow the instructions listed on ReadWriteWeb website at: http://www.readwriteweb.com/archives/turn_your_iphone_into_a_wi-fi_hotspot.php, to add the mobile hotspot capability.[23]

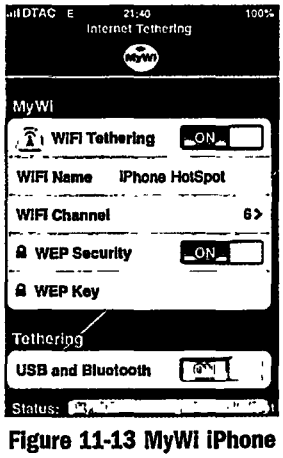


Figure 11-13 MyWi iPhone Tethering Screen[22]

PUBLIC WI-FI HOTSPOTS

Retailers are becoming increasingly aware that the average customer enjoys the freedom of having Internet connectivity on the go. Therefore, many businesses have begun offering free Wi-Fi as a service to their patrons. Starbucks, a popular destination among coffee drinkers, launched a "...no-charge, registration-less and limitation-free Wi-Fi initiative..." in hopes of, "...introducing a seamless and entertaining Web experience for all mobile devices..."[24] Many other businesses are following the free Wi-Fi trend and have already begun or have plans in the works to provide free wireless Internet access to their customers.

AT&T's Free Wi-Fi Hotspots

Wireless carriers, like AT&T, have also started offering free public Wi-Fi hotspots in metropolitan areas to help mitigate issues related to crowded wireless data networks. AT&T launched a completely free outdoor wireless hotspot in New York's Times Square that provides complimentary Wi-Fi access to AT&T customers. The company's broadband and wireless customers can take advantage of the wireless hotspot using their smartphones, laptops, and other wireless devices. AT&T launched the pilot program to determine how the free Wi-Fi hotspot can help to decrease wireless congestion on its network. AT&T has struggled to manage the demand for data services on its network due to the use of devices like the popular iPhone, and has seen extra traffic in major cities such as New York and San Francisco cause problems for users including dropped calls and sluggish Internet access. As a result, "AT&T has also been using its more than 20,000 Wi-Fi hotspots throughout the country to offload some of the traffic. The company has offered free Wi-Fi access to its smartphone subscribers in the hopes that customers will use the Wi-Fi network when it's available rather than the slower 3G network."[25]

"AT&T said that traffic on the 3G network has grown by 5,000 percent over the past three years. The introduction this year of the Apple iPhone 4, which can shoot and upload high-definition video, and Apple's iPad, a whole new class of device, is likely to push that growth even faster."[26] AT&T's strategy to offer its customer base

[20] http://lifehacker.com/5447347/how-to-tether-your-android-phone
[21] http://www.iphone4jailbreak.org/how-to-turn-your-iphone-into-a-wifi-hotspot.html
[22] Ibid
[23] http://www.readwriteweb.com/archives/turn_your_iphone_into_a_wi-fi_hotspot.php
[24] http://mashable.com/2010/07/01/starbucks-free-wifi-2/
[25] http://www.cnn.com/2010/TECH/mobile/05/25/att.free.wifi.nyc.cnet/index.html
[26] http://www.networkworld.com/news/2010/072210-att-wi-fi-use-soared-30.html?source=nww_rss

access to free Wi-Fi hotspots appears to be working. According to the company, "users are piling on to AT&T's public Wi-Fi hotspots, racking up millions of connections in the second quarter." AT&T reported that a total of 68.1 million connections were made through phones and other devices in the second quarter of 2010; a number that is more than four times the 15 million connections logged in the second quarter of 2009. In 2010, subscribers used the network 121.2 million times; also up from the 85.5 million reported in 2009. The number of connections has increased by 30% just from the first to second quarter of this year, alone.

AT&T has stated that it intends to continue developing its Wi-Fi infrastructure, including the launch of more "hotzones", like the one piloted in Times Square. 3G iPad as well as iPhone subscribers can use AT&T's hotspots, where available. A searchable database of free AT&T hotspots can be found by visiting the following webpage: http://www.att.com/gen/general?pid=13540.

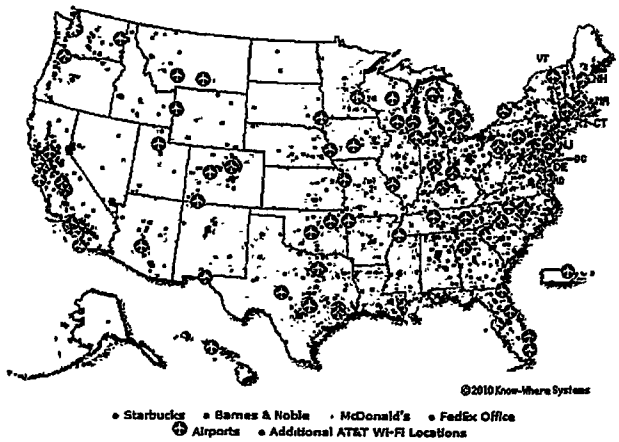


Figure 11-14 Free AT&T Hotspots Map[27]

WI-FI HOTSPOT USAGE STATISTICS

Statistics show that the availability of free Wi-Fi hotspots for public use definitely influences consumer decision-making regarding which venues to visit. According to recent In-Stat's Wi-Fi Hotspot research, approximately two-thirds of those surveyed indicated that free Wi-Fi influences their choice of venue. 31% of the group indicated that free Wi-Fi access may potentially influence their decision, and only 5% said that it would have no impact on the choice of venue.

According to Amy Craven, Market Analyst, "...research shows that while revenue may not always be directly gleaned from the hotspot offering, free Wi-Fi has a significant value in bringing customers to a venue. It's no wonder over 150 thousand café/retail venues have now deployed Wi-Fi hotspots, but not all of these are free. That's in addition to the tens of thousands of travel-related installations (hotels, airports, in-flight) worldwide."

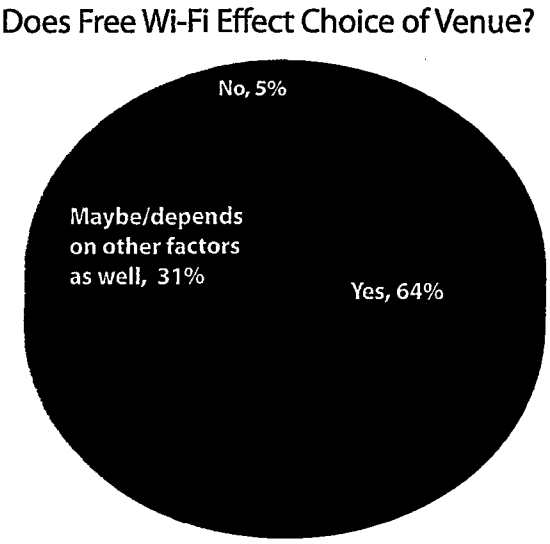


Figure 11-15 Results of Consumer Study on Effect of Free Wi-Fi on Choice of Venue[28]

Other conclusions made as a result of the research include:

- Worldwide annual hotspot connects, or sessions, will reach over 2 billion by the end of 2010 with annual hotspot connects anticipated to grow to over 11 billion by 2014
- Asia/Pacific will have about one quarter of the worldwide hotspot venues over the forecast period
- By 2012, handhelds are anticipated to account for half of hotspot connects
- The total worldwide hotspot market size will swell to 319,200 venues by year-end.[29]

Based on the In-Stat study, it is apparent that the mobile Wi-Fi hotspot market is growing exponentially. The marketplace can expect to see more mobile hotspot devices and venues that offer free Wi-Fi as consumer demand for complimentary Internet connectivity via Wi-Fi increases.

WI-FI HOTSPOT RESOURCES

There are several online resources that provide information on where to find publicly offered Wi-Fi by location including:

- Wi-Fi Zone Finder - www.wi-fi.jiwire.com
- Wi-Fi Free Spot - www.wififreespot.com

[27] http://www.att.com/gen/general?pid=13540
[28] http://www.in-stat.com/images-1/Venue_Choice.gif
[29] http://www.marketwire.com/press-release/Free-Wi-Fi-Hotspots-Influence-Venue-Choice-for-95-of-Users-Says-In-Stat-1336222.htm

- The Hotspot Haven - www.hotspothaven.com
- WiFinder – www.wifinder.com
- WeFi - www.wefi.com

The Wi-Fi Finder app, powered by JiWire, Inc., can also be downloaded to an iPhone or iPod Touch from Apple's iTunes store.[30]

LAW ENFORCEMENT IMPACT

TOR HOME INTERNET WITH BUILT IN ANONYMITY[31]

Many political activists, nonprofits, and businesses use an anonymity system called Tor to encrypt and obscure what they do on the Internet. Now the U.S.-based nonprofit that distributes Tor is developing a low-cost home router with the same privacy protection built in. The Tor software masks Web traffic by encrypting network messages and passing them through a series of relays (each Tor client can also become a relay for other users' messages). But using Tor has typically meant installing the software on a computer and then tweaking its operating system to ensure that all traffic is routed correctly through the program. "We want to make anonymity something that can happen everywhere, all the time," stated a Tor project developer. "When you are connected to a router with Tor inside, all your traffic goes through Tor without you changing your system at all. It makes it simple to use."

When a person uses Tor to bring up a webpage, the request is encrypted and sent along a random path through other Tor computers that act as relays.

An individual installation of Tor software hooks into the network by referring to a list of relays in a directory maintained by the Tor project. It is possible to block Tor by checking the same directory and preventing connections to the servers listed—a tactic apparently used by the Chinese authorities

[30] http://www.jiwire.com/iphone
[31] http://www.technologyreview.com/printer_friendly_article.aspx?id=26981
[32] See ETR Bulletin Volume 2, Issue 2, "Tor: Onion Routing for Anonymity".

12. FROM WI-FI TO MIFI

The issue of 'Going Dark' has just been escalated to another level. While customers and field operators wrestle with finding hotspots to operate mobile devices via Wireless Fidelity (Wi-Fi) and Wireless Microwave Access (WiMAX); others are vying for space in coffee shops, bookstores or libraries to get online using cellular modems from Verizon, Sprint, T-Mobile or AT&T. Not only do these devices drain your battery; they also limit your accessibility and options for use to basically being stationary.

Two prevailing theories for how we will access the Internet in the future hinge on the success of small plastic gadgets called MiFis.[1] If National Aeronautics and Space Administration can send a man to the moon; and utility companies can provide water, electricity, phone and cable, why not have universal wireless Internet? Say good-bye to USB stick and card-slots, AT&T has introduced its first MiFi device, Sprint Nextel, has the 4G-enabled Overdrive and a thinner gadget called the ZTE Peel and Verizon Wireless offers the popular Novatel MiFi 2200 Intelligent Mobile Hotspot. The MiFi 2200 has the thickness of three credit cards, one power button, one status light and a swappable battery that looks like the one in a cell phone. Within little or no time after turning on your MiFi, wait 30 seconds, it provides a personal, portable, powerful, password-protected wireless hotspot.

Figure 12-1 Verizon MI-FI

The battery lasts for four hours per charge and offers 40 hours of standby, and Verizon uses its 3G (high-speed) cellular data network to provide customers with an array of usage options.[2]

The MiFi acts as a Hub creating a Wi-Fi cloud providing access and coverage for up to five people at one time. The MiFi is not only small and portable, with a range of 30 feet. Just like car keys, the MiFi can be left in a pocket, purse or laptop bag and still fire up the mobile device. Once connected, the box dials into the Verizon's network, it connects online via the personal hotspot.

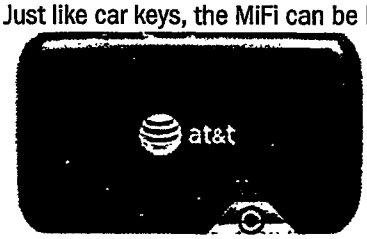


Figure 12-2 AT&T MI-FI

The MiFi allows online access to families who are travelling in a vehicle and using a variety of devices; colleagues on a business trip or corporate retreat and first responders at a disaster site. In the cell phone era where customers are trading a 'landline' for mobile phones, users could make the MiFi an at home family Internet service. One unique feature of the MiFi is the select location and mapping MiFi 2200 GPS application.

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As of October 28, 2010 to further encourage the use of portable devices and popular technology Verizon Wireless started selling a combo package (iPad and Wi-Fi + MiFi mobile hotspot).[3]

LAW ENFORCEMENT IMPACT

The technology that comprises a MiFi and a personal area network (PAN) is not new. In fact, this is no different from connecting to the Internet via a Verizon DSL modem or a wireless router. The key for users is the portability and single access to a network anywhere.

Service Providers are rapidly improving the speeds of their networks with fourth generation technology. MiFi could eventually replace wired broadband subscriptions in the same way that Americans are canceling home phone lines in favor of cell phones.[4] When industry looks at developing new products to keep up with technology the last thing that a service provider or product vendor looks at is the security aspect.

[redacted]

According to Cisco, in 2010, total mobile data traffic, including video, grew by 159% -- more than three times faster than Internet traffic traveling over wired ("fixed") communications. Earlier, Cisco predicted that growth would be 149%, so this trend is moving faster than expected.

~ Doug Webster, Cisco Senior Director

[1] http://articles.cnn.com/2010-11-18/tech/mifi.wireless.hotspots_1_wi-fi-verizon-wireless-mifi?_s=PM:TECH
[2] http://www.engadget.com/2009/03/30/verizon-mifi-2200-evdo-hotspot-leaks-out-will-sell-like-canadia
[3] http://www.computerworld.com/s/article/9191118/Verizon_to_sell_iPad_MiFi_hot_spot_combo_beginning_Oct._28
[4] http://articles.cnn.com/2010-11-18/tech/mifi.wireless.hotspots_1_wi-fi-verizon-wireless-mifi?_s=PM:TECH

13. SLURP DIGITAL EYEDROPPER

INTRODUCTION

Today, there is no shortage in the number of wireless mechanisms that can be used to transfer data from one device to another. These capabilities come in many forms including portable hard drives, Digital Versatile Discs (DVDs), Compact Discs (CDs), Zip discs, and Universal Serial Bus (USB) drives. Over the years, the devices that are used to transfer data have become more inconspicuous, like USB drives that resemble tubes of lipstick, double as a fancy designer necklace, or come attached to Swiss Army knives. Many of these devices also employ additional functionality like the ability to receive and transmit data wirelessly.

A former MIT Media Lab student has followed this trend by creating a gadget that at first glance seems like a simple eyedropper. The device, called Slurp because of its ability to suck up information and its resemblance to a typical eyedropper, is another example of how objects that may be disregarded as common items, can actually be tools used as a means to transfer data quickly and discretely.

HOW SLURP WORKS

Slurp was created as a, "tangible interface for manipulating abstract digital information as if it were water." The eyedropper, which can, "extract (slurp up) and inject (squirt out) points to digital objects," allows connected desktops and machines to facilitate a wireless data transfer from desktop-to-desktop, or from a desktop to another device.[1]

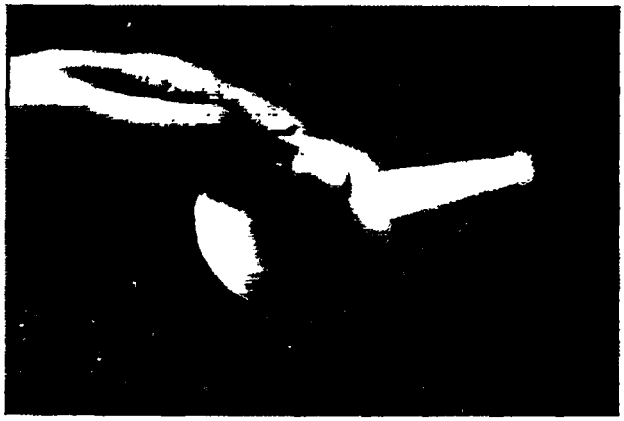

Figure 13-1 Slurp Digital Eyedropper

The Slurp tool is said to be different from existing work done in the area of abstract digital media. As such, "Slurp allows for the extraction of digital media from physical objects and the selection of an appropriate display device to access it from." Slurp actually contains digital information as opposed to working as a hyperlink. It also offers both haptic[2] and visual feedback, thus eliminating the need for visible tags on accessed objects.

Slurp is composed of two parts: the digital eyedropper, and the IR nodes.[3] To use the device, a person would simply extract data by touching the screen with the Slurp device, pointing it at an object or remote display, and then squeezing the eyedropper's bulb; much like a regular dropper would be used to suck up a liquid. After the digital object is extracted, it can be "squirted out" or injected by touching the screen with the Slurp device, pointing it at a remote display, and once again squeezing the bulb. Essentially, this process is facilitated by a small pointer that is passed between the Slurp eyedropper and the IR node. All related files are transferred, in the background, over the network in a process that is transparent to the user.

Slurp is also used as a mechanism for storing data. It indicates that it is full when it is pointed at an IR node and the stem lights vibrate, much like a liquid that is bubbling to be released. During the injection process, light travels from the Slurp's bulb to the stem, and then fades. Gentle presses of a full Slurp's bulb will inject data into the targeted data object while still retaining the data in the bulb for future injections. The bulb remains illuminated while data is injected. A full Slurp that is pressed firmly will inject and clear all of the data.

IR NODES

In the Slurp eyedropper, each IR node is connected to a display or object (auditory, visual, and so forth), that is powered by a Personal Computer (PC). Since they are self-contained and less costly, IR nodes that operate from a microcontroller may also be used and potentially, "...could be attached to computationally passive unidirectional objects such as buildings, artwork, or trees for locative-media interactions."

MULTISENSORY FEEDBACK

Using a vibrotactile actuator, users can search for digital signals within any given space. This can be likened to a beeping metal detector or the sounds emitted from a Geiger counter[4] indicating the presence of objects that are not visible to the user. When a digital object is targeted, the Slurp eyedropper displays a different feedback for a

[1] http://www.engadget.com/2010/07/05/slurp-digital-eyedropper-sucks-up-injects-information-wireless/
[2] Haptic: relating to or based on the sense of touch; characterized by a predilection for the sense of touch
[3] IR Nodes use infrared data communication (IrDA) to act as a gateway between Slurp and the objects with which it communicates.
[4] Geiger counter, also called a Geiger-Müller counter, is a type of particle detector that measures ionizing radiation.

discrete or a continuous object.[5] Once an empty Slurp is pointed towards an IR node, the Slurp's stem is illuminated and reflects the color of the targeted object, much like how an eyedropper assumes the color of the liquid that it is placed in. In the extraction process, light travels from the stem to the bulb, which remains in the bulb until information is injected. When injection occurs, light moves from the Slurp's bulb to its stem, and then fades out.

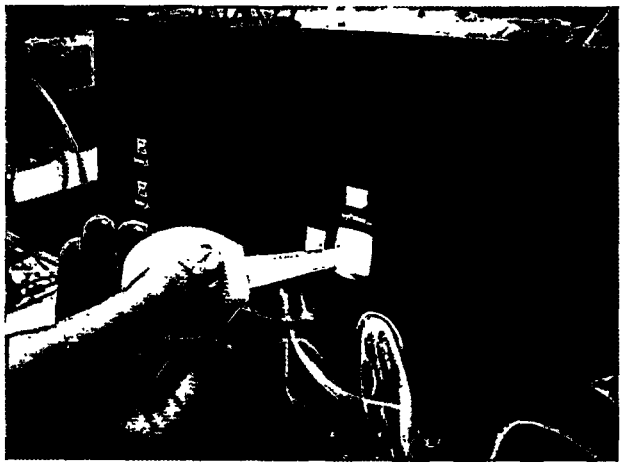

Figure 13-2 Slurp Injecting a Digital Object onto a Computer Screen[6]

LOCATIVE MEDIA

Locative media, also known as location-based media, is the linking of digital objects to physical locations, and is achieved through the use of camera phones, text messages, and two-dimensional (2D) barcodes. In locative media, 2D barcodes act as pointers, aimed at locations on the Web or a type of hyperlink. In the future, it is expected that media will be linked to physical objects, locations, and people; the Slurp eyedropper could be used to transfer data among them. When Slurp is pointed at a digitally active object (e.g., a music video), the eyedropper vibrates and is illuminated. Once this occurs, the user can extract, and then inject, the object into a container (e.g., a watch or cell phone) for later use.

ADDITIONAL SLURP FUNCTIONALITY

Slurp functions in a manner that is similar to a USB drive and has the ability to work remotely by pointing it in the direction of the display (e.g., an audio or video object). It also works with non-visual displays (e.g., speakers); this feature has yet to be implemented on most systems with multiple displays.

POTENTIAL SLURP USES

Adding Slurp to Siftables, "a tangible sensor network platform based on multiple, small graphical displays," is a logical next step for the technology according to the inventor and other Slurp collaborators. This would provide users the capability to navigate through large video media libraries on a Graphical User Interface (GUI) and extract them straight from a monitor. Slurp could potentially be used to transfer video between devices, which would leverage a GUI's scalability and Siftables' spatial and tangible properties.[7]

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LAW ENFORCEMENT IMPACT

It is not only the large number of devices that are available that can be used by targets to obtain and transfer data that poses a threat to Law Enforcement (LE). New wireless data storage technologies, [redacted] Devices like Slurp, designed to appear as an eyedropper and not a typical wireless storage device, [redacted] Additionally, the actual act of capturing or transferring data may easily go undetected. Because of it's small, inconspicuous design and portability, [redacted]

USING WPS TO DETERMINE LOCATION[8]

Eye-Fi Cards use Wi-Fi Positioning System from Skyhook Wireless (WPS) for geotagging purposes. WPS is similar but not the same as the Global Positioning System, used in location devices. WPS uses surrounding wireless networks instead of satellites to triangulate the location photo was taken. The Eye-Fi Card detects the Wi-Fi networks in the area, records their MAC addresses, but does not connect. MAC addresses are stored on the card with the picture until the photo is ready to be uploaded. Once the card comes into contact with a configured wireless network the photos begin transferring, WPS data is sent to Skyhook. Skyhook translates and triangulates the WPS data, creating a latitude and longitude, then sends data back to the photograph where the Eye-Fi Server writes to the EXIF.

[5] Discrete objects generate a short burst of vibration and a static color in the stem. Continuous objects (such as video media) generate continuous feedback to mirror their current state.

[6] Images taken from: http://zig.media.mit.edu/Work/Slurp

[7] Ishii, Kumpf, Vazquez, et. Al. Slurp: Tangibility, Spatiality, and an Eyedropper. MIT Media Lab.

[8] http://support.eye.fi/support-resources/troubleshooting/networking-geotagging/why-arent-my-photos-geotagging-or-at-the-right-location/

14. HUMAN DATA TRANSMISSION

INTRODUCTION

Technology continues to explore several alternative means of communicating. In addition to already existing forms of voice, written, and electronic communication, new technologies are being created that allow users to communicate through less traditional means. Researchers are experimenting with human data transmission technology, a novel idea in the communication arena, which uses the human body to transfer data from one point to another.

ALPS ELECTRIC-FIELD COMMUNICATION MODEL

ALPS has created an Electric-field Communication model expanding on the concept behind TransferJet, "...a Close Proximity Wireless Transfer technology featuring simple operation, safe connection, and efficient transfer of data,"[1] and employing the use of the human body as a transport medium for transferring data between two devices. The model, which ALPS unveiled at the latest Tokyo Gadget Fair, functions through electric field transmissions that are communicated through the human body.

The electric field transmissions in ALPS' Electric Field Communication model use the human body to transfer data through electric field modulation, which creates signals that are sent and received through it. Communication is initiated by simply placing the hand over a sensor. As a result of its easy usability, the ALPS model is thought to be suitable for applications such as ID cards or keyless automobile access.

With this model, "you can network various devices like a cellphone, camera, watch, tonometer, and pedometer just by touching them." In a demo of the tool, "...one person held a mockup cellphone displaying one of three images. The user held the phone in one hand, picked one of those images, and then placed his or her other hand against a computer panel, whereby that image was displayed on an overhead machine." Another demo showed, "...two people having devices pocketed and sharing data between the two via hand touching..."

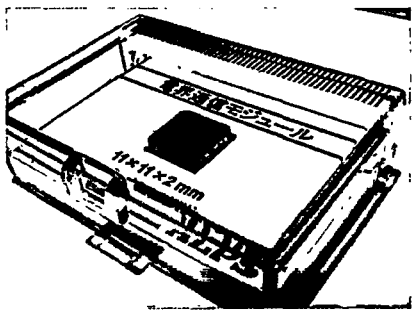

Figure 14-1 ALPS Electric Field Communication Model[2]

The Electric-field Communication model is very small and can only be powered by a button battery. It is anticipated that in the future, the device may be used to advertise products and services, allowing people to touch a poster or sign to have information transferred directly to their cellphone. The Electric-field Communication model already has the ability to conduct small data transmissions such as swapping phone numbers and addresses. According to an ALPS representative, "high-capacity data transmission can be done using multiple people in theory, but they have to be holding hands all the while so it sounds a bit too impractical. Data can be transmitted by anyone regardless of age and sex..."

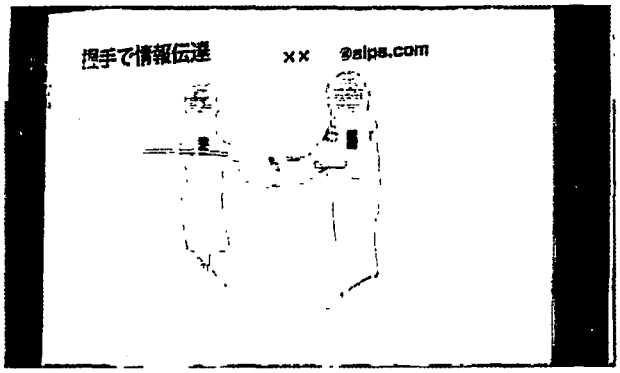

Figure 14-2 Demo Showing Data Transference through a Hand Shake[3]

MICROSOFT SKINPUT

A graduate student at Carnegie Mellon University and former intern at Microsoft Research, has developed a working prototype of a system called "Skinput" that essentially turns a person's hand and forearm into a keyboard and screen.

"Using Skinput, a person could tap their thumb and middle finger together to answer a call; touch their forearm to go to the next track on a music player; or flick the center of their palm to select a menu item. All of these sign-language-like movements, which are customizable, would control a gadget in a person's pocket through a Bluetooth connection. When fitted with a pico-projector, the Skinput system could display an image of a digital keyboard on a person's forearm. So, using Skinput, someone could send text messages by tapping his or her arm in certain places -- without pulling the phone out of a pocket or purse."

[1] http://www.transferjet.org/en/tj/tj_overview.html
[2] http://en.gigazine.net/index.php?/news/comments/20091006_alps_ceatec_japan_2009/
[3] http://www.japanretailnews.com/2/post/2009/10/alps-electric-sends-date-through-the-human-body.html

Skinput is a technology that aims to make communication more "natural" by, "...letting people communicate with their gadgets by gesturing, using sign language or tapping on their hands, fingers, and forearms."

To use Skinput, a person must wear an armband with sensors (the prototype is an elbow brace lined with 10 sensors), that are able to pick up low, but audible sounds with frequencies ranging from 25 to 78 hertz.

Once a Skinput user taps their thumb and middle finger together, the impact acts as a catalyst and sends ripples down the skin and through the bones in the person's arm. The arm band's receivers then read the sound waves and determine what gesture the person made, and then proceeds to pass that information on to a telephone.

Skinput can differentiate whether a person tapped a middle finger or an index finger, as the movements each impart a unique sound to the receivers. Once the system becomes accustomed to the sound of a user's arm, a process that generally takes one to two minutes, the user can begin to use Skinput as desired. Skinput allows a user to tap their palm as a signal to unlock a door or to tap virtual buttons on an arm to power on a TV and search through channels.[4]

USING SKIN TO TRANSFER BROADBAND SIGNALS

An experiment conducted by researchers at Korea University demonstrated that human skin is an energy-efficient conduit for data transmission. Performed with small, flexible electrodes that are the approximate width of three human hairs, the experiment showed that data can be transmitted through skin at a rate of 10 Megabits per second (Mbps).

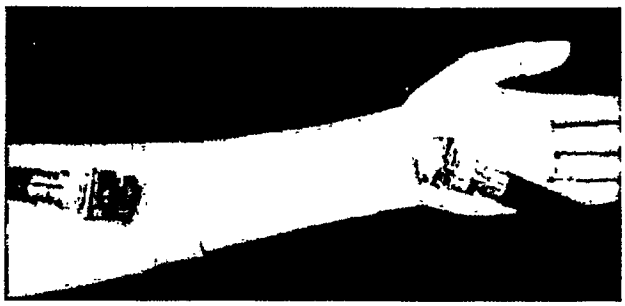

Figure 14-3 Human Arm Used to Transfer Data over Broadband Signals[5]

South Korean researchers that administered the test placed electrodes approximately 12 inches apart on the subject's arm, and found that low-frequency electromagnetic waves were able to travel through the skin easily and without any outside interference. The study, which improved on previous attempts that used tiny metal electrodes coated with a silicon-rich polymer, allowed the device to be bent at a 90-degree angle 700,000 times without incident, and proved that human skin can be used as a conduit for transferring data.

REDTACTON

RedTacton is a technology designed to use the human body as a network transmission path. Considered a Human Area Network (HAN) technology, RedTacton is unlike wireless and infrared. It operates by forming a transmission path when part of the human body comes in contact with a RedTacton transceiver. Once the body part is separated from a RedTacton transceiver, communication ends. Communication through RedTacton is initiated when embedded devices or terminals carried by the user are linked in a variety of combinations according to a user's

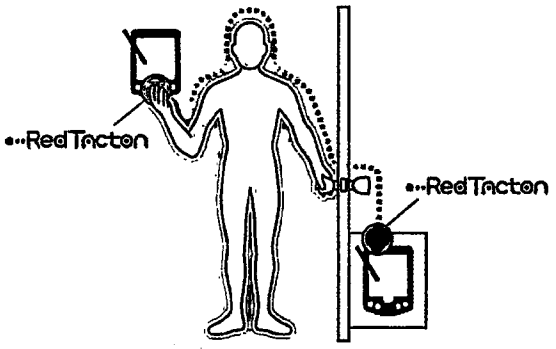

Figure 14-4 Illustration of RedTacton Data Transfer Through Human Body[6]

physical movements through hands, fingers, arms, feet, face, legs, torso, and so forth. RedTacton usability is not impacted when a user wears clothing or shoes. It can communicate data through the human body at speeds up to 10 Mbps.

RedTacton has three primary functional features:

- Touch: Touching, gripping, sitting, walking, stepping and other human movements can be the triggers for unlocking or locking, starting or stopping equipment, or obtaining data
- Broadband and Interactive: Duplex, interactive communication is possible at a maximum speed of 10 Mbps. Because the transmission path is on the surface

[4] http://www.cnn.com/2010/TECH/04/19/microsoft.skinput/index.html
[5] http://gizmodo.com/5493931/south-korean-scientists-transmit-broadband-signals-through-human-arm
[6] http://www.redtacton.com/en/info/index.html

of the body, transmission speed does not deteriorate in congested areas where many people are communicating at the same time

- Any-media: In addition to the human body, various conductors and dielectrics can be used as transmission media. Conductors and dielectrics may also be used in combination[7]

How RedTacton Operates

The following steps detail how the RedTacton technology works:

1. The RedTacton transmitter induces a weak electric field on the surface of the body.
2. The electric field sensor (transistor or photonic electric field sensor) detects the electric field that reaches the RedTacton receiver.
3. Signals are processed in the receiver circuit and the data is downloaded.

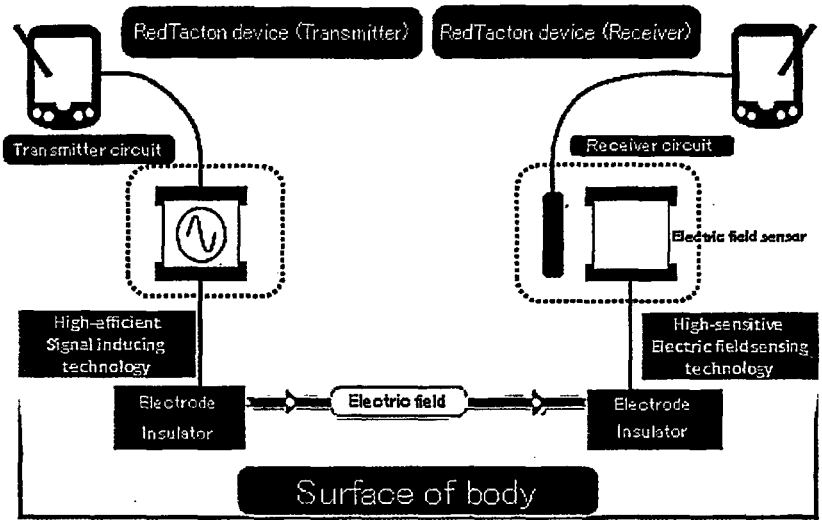

Figure 14-5 Process for Transferring Data from RedTacton Transmitter to RedTacton Receiver[8]

The RedTacton transmitter sends data based on fluctuations in the weak electric field induced in the human body. The electric field is then received using sensing technology that is highly sensitive to the body's electric field. RedTacton's super-sensitive electric field sensing technology is used to measure the weak electric fields induced by the ultra efficient alternating electric field induction technology, developed by RedTacton's creators, NTT (Japan).

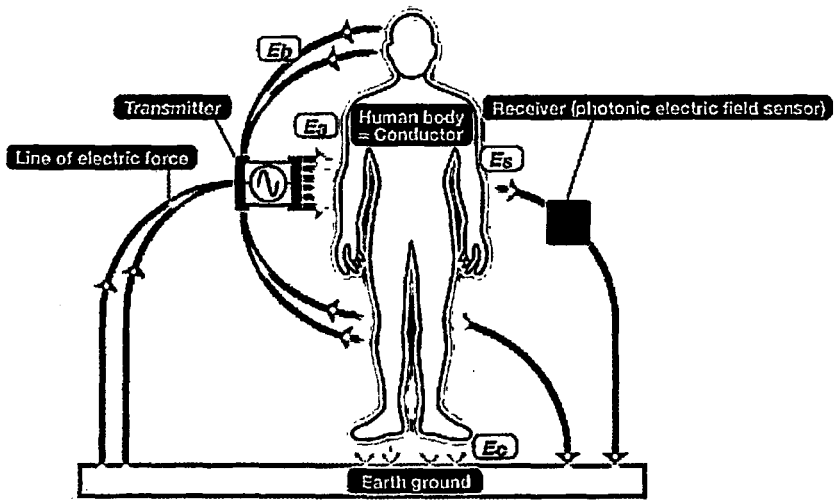

Figure 14-6 RedTacton Communication Mechanism Diagram[9]

RedTacton Prototypes

According to RedTacton, the following RedTacton security device and data transmission device prototypes have been developed, or are currently in development:

[7] http://www.redtacton.com/en/feature/index.html
[8] http://www.redtacton.com/en/info/index.html
[9] Ibid

Table 14-1 RedTacton Protypes[10]

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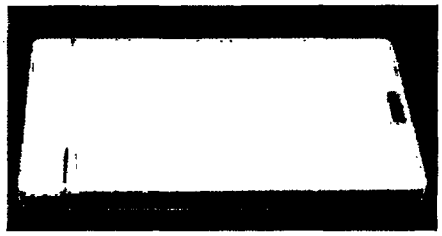
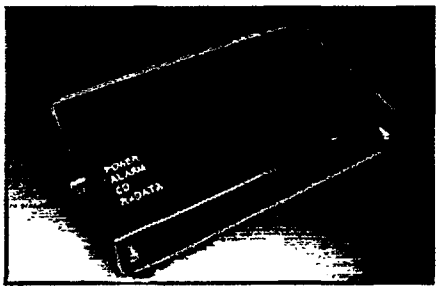
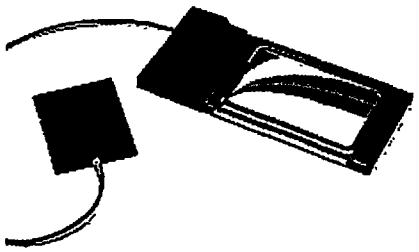
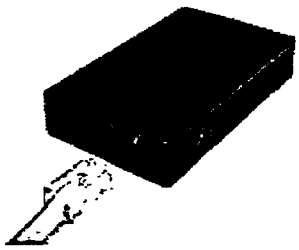
Security Devices (Development Completed)	
Portable Card-Size Transmitter • Transmission rate: 230 Kbps • Protocol: Proprietary protocol • Transmission method: Unidirectional	
Embedded Receiver • Transmission rate: 230 Kbps • Protocol: Proprietary protocol • Transmission method: Unidirectional • External device interface: 10/100BASE-T, RS232C	
Data Transmission Devices (in Development)	
PC Card Transceiver • Transmission rate: 10 Mbps • Protocol: TCP/IP • Transmission method: Half-duplex • Terminal interface: PCMCI	
Embedded Receiver • Transmission rate: 10 Mbps • Protocol: TCP/IP • Transmission method: Half-duplex • External device interface: 10BASE-T	

LAW ENFORCEMENT IMPACT

HAN technology is responsible for ground-breaking developments in the way that people communicate. In the future, conventional voice-to-voice calling and data transfer methods may no longer be required to pass information to a person or a device. Devices that are based on HAN technology allow people to communicate and initiate tasks with a simple handshake, tap on the arm, or by placing a hand over a sensor. Such devices not only diversify the way that people share information,

[redacted]

[10] http://www.redtacton.com/en/prototype/index.html

15. GESTURE-RECOGNITION

INTRODUCTION

The act of placing a telephone call or selecting a song to play on an MP3 player has gone through many changes over the years. Making a call on a cell phone is no longer limited to a user pressing buttons on a compact dial pad or touchscreen. Scrolling through an entire collection of music to find a specific song, which was once the only way for a user to pick and play their favorite tune, is now just one of many options. Voice-activated calling allows users to simply speak the name or number of the person with minimal or no physical contact with their phone, and users can utter commands on their smartphones or MP3 players to search for addresses, contacts, and other data. These examples are representative of a growing movement exploring the potential of gesture-based mobile device capabilities, and a progression toward touch-less telecommunication.

Expanding on the idea of touch-less functions, a new technology known as gesture-recognition is the latest way that individuals use their cell phones and other mobile devices to perform tasks and communicate with each other. "Gesture-recognition is a topic in computer science and language technology with the goal of interpreting human gestures via mathematical algorithms. Gestures can originate from any bodily motion or state but commonly originate from the face or hand." Gesture-recognition can be considered a means for computers to understand human body language, as well as a way to facilitate communication among humans and machines, which at present, is mostly limited to text and Graphical User Interfaces (GUIs) such as the keyboard, mouse, and screens.[1]

Applications with gesture-recognition capabilities are being integrated into mobile and gaming devices and have infiltrated the marketplace.

APPLICATIONS

Several companies have begun advertising new gesture-recognition tools and software for mobile phones. A few of these technologies are described in the sections that follow.

eyeCan

Developed by the company eyeSight, "eyeCan is a pure software solution, which provides a unique interface to control mobile phone features and applications." eyeCan software uses eyesight's Touch Free Interface which, "...allows the user to interact with the mobile device easily and intuitively, without touching the keypad or touchscreen." The eyeCan technology operates with any standard phone containing a built-in camera, which it uses in combination with advanced real-time image processing algorithms to track a user's hand motions and translate them into user actions.[2]

eyeCan operates by recognizing the four basic hand gestures, that are then translated into various actions such as skipping tracks, volume control of a media player, scrolling through pages in an E-book viewer or Web browser, switching content channels in a media streaming application, and so forth.[3]

Using a mobile phone's front-facing camera, eyeCan provides users with the capability to navigate through picture galleries, send Short Message Service (SMS) messages, and place phone calls using "swipe" gestures that are executed a few inches in front of a mobile device. Other features include pause-and-play control of a music player using a temporary "hold" gesture.[4]

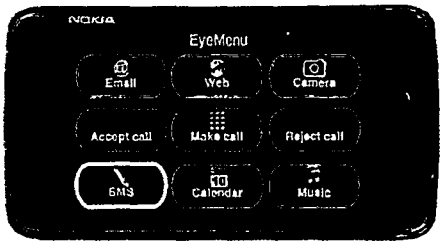


Figure 15-1 Eye Menu on Nokia N900[5]

EyePhone

The EyePhone, created by a team of researchers at Dartmouth College, is an eye tracking technology that, "lets users browse through mobile phone menus with the blink of an eye."[6] The EyePhone system works by creating a template of a user's open eye when the individual initially uses the system. Once a template is created, it is saved in the device's persistent memory and retrieved when the EyePhone is invoked. In the EyePhone's current implementation, the system is trained individually (e.g., an eye template is created for each user when the application is used for the first time). In future iterations, it is anticipated that the eye template training will be facilitated through the use of the EyeMenu, a customizable shortcut for accessing EyePhone functions.

[1] http://en.wikipedia.org/wiki/Gesture_recognition
[2,3] http://www.eyesight-tech.com/products/eyecan/
[4] http://www.pcworld.com/article/198552/touchless_gesture_control_coming_to_android_devices.htm
[5] http://www.cs.dartmouth.edu/~tianyuw/eyephone.pdf
[6] http://www.technologyreview.com/computing/25369/?a=f

The EyePhone is designed to map the position of a user's eye to one of nine buttons, which are highlighted once the EyePhone detects the eye in the position mapped to the button. Once in the position of a corresponding button, a user then blinks their eye to launch the associated application.[7]

"EyePhone runs on a Nokia 810 smartphone. The program tracks the position of an eye relative to the screen (rather than where a person is looking). A user must move the phone slightly so the icon is directly in front of the eye and then select an application by blinking. The program places an "error box" virtually around an eye, and can recognize the eye as long as it doesn't move outside of this box. The phone app divides the camera frame into nine regions and looks for the eye in one of these regions."[8]

Moove MP3 Player

eyeSight is also the creator of the Moove MP3 player, an application that uses gesture-recognition technology to allow users to control an MP3 shuffler using hand motions. Moove works by having the user place their hand over the phone to initiate the playing of a song. A song can be paused by the user placing a hand over the phone a second time. With the ease of the Moove application and the phone's camera, "a hand gesture above the phone will skip to the next song...wave again and skip to the next, and to the next..." A "Sync" button is also available to add new songs to a playlist.[9]

Tokyo's Touchless Camera System

Researchers at the University of Tokyo's Ishikawa Komuro Laboratory have produced a camera system that allows users to interact with their cell phones without actually touching them. The system was designed to attach to a mobile device and track suspended finger movements and then translate them into commands.

"The camera recognizes if the finger is moving toward it and away from it and at what speed. This lets a user move a mouse, zoom and scroll pictures, and digitally draw and type, without ever touching the screen."[10]

GAMING

Gesture-recognition technology is a new trend that can be seen in the releases of popular gaming technology. Abandoning traditional remote controls, gamers have the opportunity to navigate through games and perform other functions with simple gestures and body movements.

Microsoft Kinect

One of the highlights of the Electronic Entertainment Expo (E3) 2010 press conference was the unveiling of Microsoft's Kinect for Xbox 360, a motion control system formerly titled "Project Natal". Released on November 4, 2010, the Kinect, "...can sense and respond to users' body motions as well as their voices..."[11]

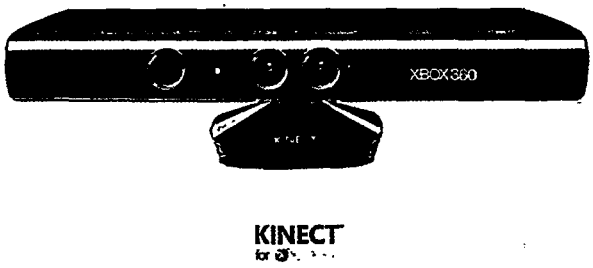


Figure 15-2 Microsoft Kinect for Xbox 360 Console[12]

"The slim black Kinect sensor plugs directly into any Xbox 360. Despite its small size, the Kinect device contains a camera, audio sensors, and motion-sensing technology that tracks 48 points of movement on the human body. It has the ability to recognize faces and voices."[13] Kinect is able to conduct full-motion human body tracking at 30 frames per second, and is not affected by surroundings including furniture or what the user is wearing.

With Kinect technology, "...users will be able to access and control Netflix movies or TV shows through Xbox Live with nothing more than a wave or two of their hands and a voice command to stop, pause, or play. They will be able to have video chats with friends, watch pro sports games via a Microsoft content partnership with ESPN and, of course, play games." Microsoft's Kinect will also contain, "other features of Xbox Live, including the new content from ESPN, Facebook, Last.fm, and Twitter..."[14]

Momo for Windows Mobile

Momo for Windows Mobile, created by the company GestureTek, is a new technology that uses a cell phone camera to track objects and motions within the camera's field of view. Momo's engine defines interfaces for two trackers. The first is a Motion tracker that determines interaction by following specific movements; the other is the Mosaic tracker, which tracks objects such as faces and hands. 'Momo makes possible groundbreaking mobile games that can respond to hand motions over menu items and even track the position of the user's head.' The tool allows users to control and direct actions on their phone using specific hand or body gestures and does not require

[7,8] http://www.cs.dartmouth.edu/~tianyuw/eyephone.pdf
[9] http://www.eyesight-tech.com/games-and-applications/moove/
[10] http://www.technologyreview.com/blog/editors/25102/
[11,12] http://reviews.cnet.com/8301-21539_7-20007681-10391702.html?tag=mncol;pm
[13,14] http://www.microsoft.com/presspass/features/2010/jun10/06-13kinectintroduced.mspx

movement of the device itself.

EyeMo

EyeMo, which uses a mobile device's camera to sense and report device motion, is now available for Android devices. For people with camera-enabled Android phones, "once the software is enabled, users can shake, rock or roll their phone to play games, answer calls, shuffle playlists, navigate maps, scroll, pan, zoom, turn pages and even browse the Web - all without pressing a button or touching the screen."[15]

LAW ENFORCEMENT IMPACT

[redacted]

[redacted] Users could also abuse gesture-recognition to communicate with associates. Providing the capability to scroll through pictures, draw and type digitally, and peruse phone menus that can easily take a user to the Web, e-mails, and so forth, [redacted]

Gesture-recognition technology is clearly within the early stages of development. It has the potential to alter how we execute command and control functions, as well as how we interface with computer and communication devices. [redacted] This technology is definitely one to watch.

EYESIGHT BRINGS GESTURE CONTROLS TO ANDROID TABLETS, WINDOWS-BASED DEVICES[16]

EyeSight has been bringing its hand waving user interface to all sorts of mobile devices for some time now, and it's now expanded things yet again. Following up its launch on Android last summer, the company has announced that its gesture-recognition software has been tailored specifically for Android tablets and other "computer-based" Android platforms. It announced that it's now available for Windows-based devices as well. Like before, the software is able to work with just about any built-in camera, and the company says that it has been "highly optimized" for mobile platforms with low central processing unit and memory requirements. This capability is not something that is available to users directly - it's up to developers to license it and include the functionality in their applications.

[15] http://www.prnewswire.com/news-releases/gesturetek-launches-gesture-control-software-for-androidr-and-a-new-tracking-engine-for-windowsr-mobile-at-the-consumer-electronics-show-80912557.html

[16] http://www.engadget.com/2011/02/03/eyesight-brings-its-gesture-controls-to-android-tablets-windows/

16. MICROSOFT WIFFLER

INTRODUCTION

Microsoft Researchers have been working on a technology that would let mobile phones and other third generation (3G) devices automatically switch to public Wi-Fi even while the device is traveling in a vehicle. The technology is dubbed Wiffler and earlier this year, researchers took it for some test drives in Amherst, Massachusetts (MA), Seattle and San Francisco.[1]

Wi-Fi is available only about 11 percent of the time for a mobile device in transit, compared to 87 percent of the time for 3G availability. Wi-Fi was not designed as a mobile access technology. At best, mobile devices can use Wi-Fi for short periods of time. The Wiffler protocol allows devices to offload nearly half of its data from 3G to Wi-Fi. How does this work? Wiffler is smart about when to send the packets. It doesn't replace 3G, it augments it and transmits over Wi-Fi simultaneously, allowing users to set Wi-Fi as the delivery method of choice when it is available -- and when an application can tolerate it. Not every application can handle even a few seconds delay in the stream Voice-over-Internet Protocol (VoIP) -- and Wi-Fi tends to drop more packets than 3G does. But many apps can handle even a minutes-worth of delay perfectly well (e.g., messaging).[2]

Wiffler uses what researchers call "prediction based offloading" in which it determines how likely it is to travel within the area of an acceptable Wi-Fi hotspot within a certain time frame. A car in an urban area discovers frequent hotspots and predicts finding another one quickly. If traveling on a highway and Wiffler does not locate a hotspot in a while, it figures it won't find another one soon. If the device is unable to find a hotspot within a predicted maximum delay time it switches to 3G.

"We try to ensure that application performance requirements are met. So, if data needs to be transferred right away (e.g., VoIP) we do not wait for Wi-Fi connectivity. But, if some data can wait for a few seconds for Wi-Fi instead of transmitting right away on 3G, this reduces 3G usage."

"The second feature is that both connections can be used in parallel instead of using only one. So, if some data cannot be transferred using Wi-Fi alone within its latency requirement, both 3G and Wi-Fi are used simultaneously. This parallel use is different from a handoff from one technology to the other, and it better balances the sometimes conflicting goals of reducing 3G usage and meeting application constraints."[3] It is similar to mulit-network load balancing.

The test consisted of running Wiffler units on 20 buses in Amherst, MA as well as in one car in Seattle and one at the San Francisco airport. The Wiffler unit itself was a proxy device that included a small-form factor computer, similar to a car computer (no keyboard), an 802.11b radio, a 3G data modem, and a GPS unit. The 3G modem was using HSDPA-based service via AT&T. With today's smartphones, the Wi-Fi/3G combo tends to use Wi-Fi connectivity only when stationary; the Wiffler technology provides automatic combo management that permits optimal application performance.

Currently, it is not known when the Wiffler will be available on the commercial market.

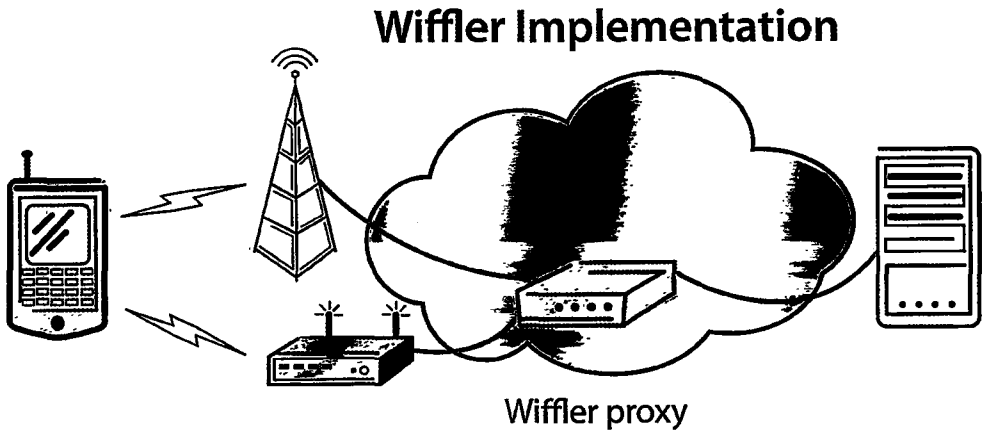


Figure 16-1 Wiffler Implementation

[1] http://www.networkworld.com/community/blog/microsoft-wiffler-lets-smartphones-use-free-w?t51hb=

[2] Ibid

[3] The results of the test was presented in a paper, Augmenting Mobile 3G Using WiFi (PDF), presented in June 2010 at the eighth annual International Conference on Mobile Systems, Applications and Services.

17. COUNTERFEIT GADGETS

INTRODUCTION

The introduction of devices such as the iPod, iPhone, and iPad, Apple's recently released touchscreen tablet, have proven to be very popular among consumers. Because of their popularity, and the inability for some interested buyers to get their hands on the devices legitimately, a growing gray market has emerged in places like Beijing, China. The gray market provides options for users that cannot afford to pay the retail price for Apple's mobile devices, as well as individuals that live in areas where the iPad and the iPhone 4 just recently became available. These counterfeit devices often appear to look very similar to the real iPad and iPhone sold in stores but are available for a much cheaper price. The functionality of fake iPhone 4 models available on the gray market varies and some phones even offer capabilities that Apple's licensed products do not. For this reason, Law Enforcement (LE) should be aware that these phony mobile devices exist, and understand that they may be used to perform functions that Apple manufactured devices cannot.

BACKGROUND

Three Wi-Fi models of the Apple iPad went on sale in China on September 17, 2010. Apple first released the iPad in the United States back in April 2010, and in late May 2010 made the device available in Australia, Canada, France, Germany, Italy, Japan, Switzerland, and the U.K.[1] The iPhone 4 was officially released in China on September 25, 2010, three months after the phone's initial launch in the United States.[2] A thriving Chinese gray market emerged in between the time that the iPhone 4 and iPad were released in the U.S. and when the devices were made available for legal purchase in China.

Despite a significant portion of China's population living in poverty or on low income, the iPhone 4 can be sold for as much as $1,000 once it is unlocked.[3] For many Chinese buyers, "Apple is a sign of coolness," suggesting that the widespread popularity of both the real and counterfeit iPhone 4 is related to the status that it conveys. 125 "Most people in China can only dream of being able to afford an expensive phone. But millions of Chinese are developing a taste for luxury goods, and Apple products have joined Louis Vuitton bags as totems of wealth."[4] The Chinese gray market provides easy access to high-quality replicas of trendy Apple gadgets for consumers that were too anxious to wait for the official release of the iPhone 4 and iPad or those that cannot afford the premium cost to buy these items.

Figure 17-1 Ciphone 4[5]

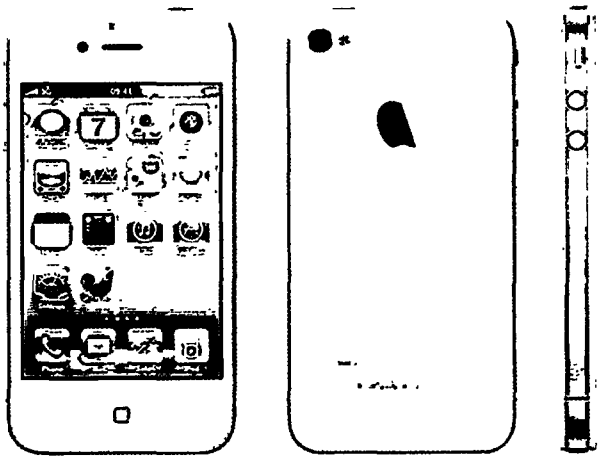


Figure 17-2 Apple iPhone 4[6]

Before their official September 2010 release, the iPhone 4 and iPad were readily available in China. Available in electronics malls in major cities like Shanghai and Beijing, the sale of fake Apple devices is so lucrative that it can be considered a serious competitor for Apple. Phones sold on the gray market are smuggled from the United States and Hong Kong, where devices went on sale long before their authorized release in China. The smuggled iPhone 4 sells in China for $800 to $1,700, depending on the storage size. An iPad with 64 gigabytes (GB) goes for

[1] http://www.computerworld.com/s/article/9184958/Apple_slates_China_iPad_launch_for_Friday
[2] http://www.computerworld.com/s/article/9187998/Chinese_Apple_fans_line_up_for_iPhone_4_launch
[3] http://www.macworld.co.uk/ipod-itunes/news/index.cfm?newsid=3240773
[4] http://www.nytimes.com/2010/09/23/technology/23iphone.html?_r=3&pagewanted=1&src=busln
[5] http://www.clonedinchina.com/2010/07/ciphone-4-clones-iphone-4-runs-windows-mobile.html
[6] http://images.intomobile.com/wp-content/uploads/2010/10/white-iphone-4-big.jpg

Law Enforcement Sensitive Information - For Official Use Only (LES/FOUO) - Redisclosure Authorized by FBI Only

about $1,000.[7] The expensive price tag was a deterrent for many Chinese consumers that wanted to purchase the iPad and iPhone produced by Apple. As a result, users that could not afford to buy the licensed Apple iPhone 4 opted for counterfeits that are virtually indistinguishable from the real one. These counterfeit Apple phones are known in China as "Shanzhaiji", which is loosely translated as "Mountain Bandit Phones".

In China, a country well known for its production of copycat jewelry, electronics, clothing, and accessories, the growing prevalence of smartphones and other mobile devices has introduced a new marketplace for the production and selling of counterfeit items. According to BDA China, a business advisory firm based out of Beijing, "...illicit phones made up 38 percent of the handset sales in China in 2009."[8] Arguably, the popularity of Taiwan's iPhone 4 phone is based on its likeness to the real iPhone 4. Comprising a significant portion of the market share, the popularity of "Shanzhaiji" is so vast that it has allowed the gray market to become a threat to legitimate smartphone and other mobile device manufacturers.

COUNTERFEIT GADGET AVAILABILITY AND FEATURES

Many illicit phones offer the same, and sometimes more, features than the real model. One Taiwanese version of the iPhone contains a removable battery and slots for two SIM cards, which allows a user to have two phone numbers ring for the same phone. According to a Chinese gray market vendor, users can't tell the difference between this and the real thing. Apple's signature logo is displayed on the back of the phone's case, and it works with legitimate iPhone accessories including chargers and earphones. The only major difference between the Taiwanese version and the real iPhone 4 is price. The counterfeit device sells for approximately $100.

With lower end iPhone 4 imposters such as the iPhooe, which reads "iPhooe" on the back, it is more obvious these devices are not the real thing. One of the cheapest versions of the counterfeit iPhone 4 models simply reads, "Phone" on the back of the case.[9]

A lot of the newest wireless technologies come from the United States, but the market that always uses technology first is Japan, followed by other places like Korea, China, then Europe and the United States. "

~ Scott Moody, Director of Authen Tec, Inc.

Figure 17-3 iPed[10]

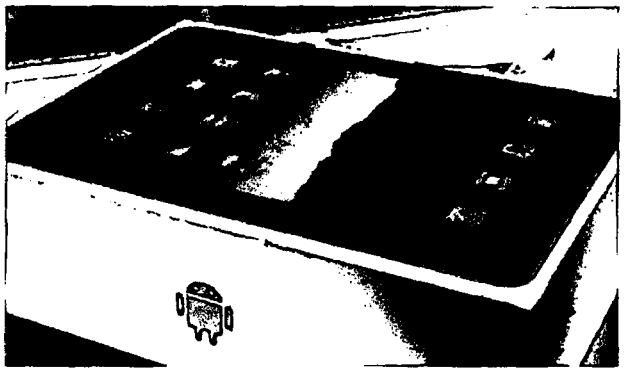


Figure 17-4 iPed Box[11]

Popular iPad alternatives such as Orphan Electronics' iPed were introduced on the gray market last summer. The iPed runs on Google's Android version 1.50 and includes 16 GB of storage and 1 GB of RAM. It also comes with a 600 MHz processor, and a 800 x 480 pixels screen resolution. The Apple iPad is built with a 1 GHz Apple A4 processor and a 1024 x 768 pixel screen. The iPad's 9.7 inch display is significantly larger than the iPed's 7 inch screen. Priced at $150, the iPed is much more affordable than the real Apple iPad, which starts at $499 for an entry-level tablet.[12]

APPLE PEEL 520

The Chinese based company, Yosion Technology, is giving users another alternative to the iPhone models available on the market. The Apple Peel 520, a hack that can transform any iPod Touch device into a cellular phone, attaches to an iPod Touch like a protective case, works as a dock connector, has an extended battery, and provides a slot for a SIM card to allow voice calls. "For less than $60, users can jailbreak their iPods, install Yosion's calling and text-messaging application, pop in SIM cards, and start making calls through the device using a headset. Previously, iPods could only be used for Voice-over-IP calls when connected to the Internet via Wi-Fi." The device can be ordered from

[7,8,9] http://blogs.wsj.com/chinarealtime/2010/08/07/ipod-to-iphone-on-the-cheap/
[10] http://ipodtouchtricks.net/wp-content/uploads/2010/05/chineseversionofipad.jpg
[11] http://www.yugatech.com/blog/wp-content/uploads/2010/08/iped-tablet.jpg
[12] http://www.foxnews.com/scitech/2010/06/01/ipad-iped-knock-off-imitation/

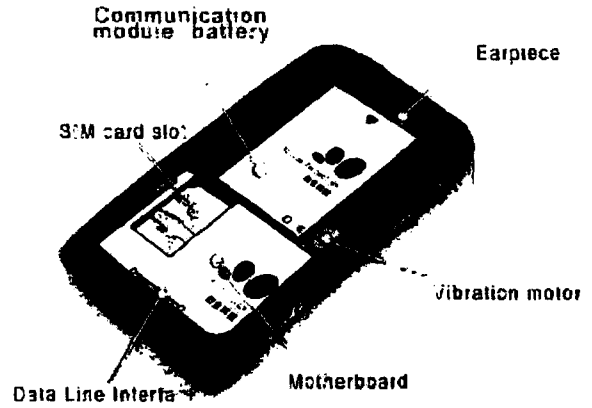


Figure 17-5 Yoslon Apple Peel 520[13]

the following website: http://www.peel520.net/.

Operating as an iPod turned phone, the device is made of soft plastic and claims to offer good signal strength and a battery talk time up to 4.5 hours. The low price of the Apple Peel 520 is one reason that the device is appealing to Chinese consumers that cannot afford to purchase a real iPhone. Comparatively, the Apple Peel 520, combined with an 8 GB iPod Touch, would cost less than $300, a fee that is lot more affordable than the iPhone 3GS, which sells for $738 with a minimum monthly fee of $33.[14]

There is a small lag time when calls are made from the iPod Touch with the Apple Peel 520, and it does not allow text messages to be deleted and forwarded. Otherwise, people that have used the device are impressed with its functionality. The most important development of the Apple Peel 520 is that it, "...illustrates the evolution of China's massive 'Shanzhaiji', or black market, phone industry." The Apple Peel 520 is novel in the sense that, "It is the first time there has been a hardware application that has changed the functionality in such a key way." "Because the iPod Touch is very cheap, there is a value proposition for people who want to save money."

The second generation Apple Peel 520 is sleeker and less bulky than the previous model, and from a distance, could be mistaken for an iPhone 4. It also allows the use of General Packet Radio Service (GPRS) data. The device is not currently available for purchase.[15]

HOW THE CHINESE GRAY MARKET WORKS

The Chinese gray market is facilitated by participants working in China and the U.S. "People wait in line at an Apple store to buy the newest iPhone for $600, paying a premium to skip the AT&T contract. They then sell the phones to middlemen, usually at electronics stores in Chinatown, for about $750." Once the phones are purchased from Apple, they are shipped to China for distribution to local shops or are placed on e-commerce websites where they can sell for up to $1,000. Once an iPhone 4 is unlocked, it is no longer tied to AT&T, and therefore, is free to be used with any local carrier. Apple limits the number of iPhone purchases to two with the use of a credit card, but the manufacturer does not track phones purchased with cash, allowing people to buy multiple phones to be sold on the gray market.

Retailers in China report that iPhones are usually smuggled into the country by people hiding them in bags or taping them to their bodies. More established smugglers are known to bring in a 100 or more iPhones a day by hiding them among other goods in shipping containers. The official release of the iPhone 4 in China has resulted in a drop in the price of counterfeit phones on the gray market, but it is not anticipated to end sales of illicit phones entirely.[16]

EMERGING COUNTERFEIT GADGET MARKETS

The popularity of counterfeit gadgets on the gray market has spread beyond China. Significant numbers of illicit cell phones are exported to countries in the Middle East and Africa, which have also proven to be successful markets for inexpensive imitation devices. According to vendors working in Beijing's electronics malls, many African customers buy fake phones in bulk to be sold in their home countries.

The Director of China research for iSuppli stated that fake phones are often purchased in China and then sold in other countries. "When exported to some emerging market countries, the products are sold as the real ones." According to BDA reports, in the previous year, illicit phone-makers were China's largest handset exporter. Fake phone producers are set to become even more prevalent overseas due to inexpensive prices, well-established distribution networks, and the ability to customize clone phones for local users. Foreign countries are expected to replace China as the primary market for illicit phones produced in China. A BDA principal analyst, said that 2.5 million smuggled iPhone handsets were sold in China in the first half of 2010, which is significantly more than the 800,000 legitimate iPhones sold. Many buyers of cloned products are foreigners that travel to China to stock up on fake phones and other goods.

[13] http://www.iapplepeel520.com/
[14] http://blogs.wsj.com/chinarealtime/2010/08/07/ipod-to-iphone-on-the-cheap/
[15] http://articles.cnn.com/2010-08-16/tech/china.apple.peel_1_apple-smart-phone-iphone-ipod/2?_s=PM:TECH
[16] http://www.nytimes.com/2010/09/23/technology/23iphone.html?_r=3&src=busln&pagewanted=print

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LAW ENFORCEMENT IMPACT

There is little regulation of the sale of counterfeit gadgets on the Chinese gray market. In fact, many smugglers and vendors appear to be apathetic about the idea that they are buying and trading devices illegally. One vendor stated, "The police won't crack down us -- it's not guns or drugs, why bother? The cellphones aren't illegal. If it's illegal, why is such a big market still open here?" A second vendor concurred, asserting, "If selling this violates the law, how come so many people are selling cellphones here illegally? If it violates the law, how can such a big market still exist?"[17] The lack of regulation over the development, trade, and sale of counterfeit gadgets can be problematic for LE. Without adequate oversight, counterfeit gadgets can be easily produced, traded, and sold to users that seek to use them to conduct unlawful activities. Even though counterfeit devices must be registered with a service provider's network,

The prevalence of counterfeit devices on the gray market and beyond poses several unique challenges for LE.

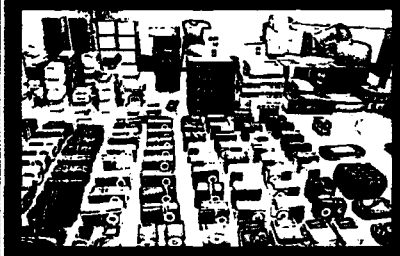
Counterfeit iPhones and tablets are widely available on the gray market at price points that are much more reasonable than the legitimate iPhone and iPad,

With features that permit two phone numbers to ring on the same device, many fake iPhones eliminate the need for two phones; this allows the

LE may find it difficult to keep up with the number of illicit iPhones and iPads and their unlawful users with the continuous introduction of new counterfeit devices.

With new counterfeit devices being introduced to the market regularly, and a growing market of unlawful users,

COUNTERFEIT IPODS AND IPHONES SEIZED FROM DOWNTOWN LOS ANGELES WAREHOUSES[18]



More than $10 million in counterfeit iPods, iPhones, and other items have been seized from a sophisticated downtown warehouse operation in a theft case started by the Los Angeles Port Police. According to the Chief of Los Angeles Port Police, "This was a well-funded operation, and the counterfeits looked very authentic. A buyer might not notice anything awry until he or she gets home and tries to hook up the device to iTunes." Investigators believe that the shipment was designed to get Apple, Inc. look a-like products on the market during the recent buzz over the Consumer Electronics Show. Some of the products, shipped from Asia, were designed to look like older Apple products such as iPod Nanos without touchscreens, which remain popular with some consumers.

The case stems from a stolen-cargo investigation, in which Los Angeles police discovered counterfeit products with an estimated street value of more than $1.4 million: stolen electronics, toys, and blankets worth about $2.5 million; and bank account receipts that indicate the operation generated more than $7 million in profits. The case highlights the lengths counterfeiters go to hide their activities - the fake devices arrived in parts meant to be reassembled and labeled before being sold.

[17] http://www.washingtonpost.com/wp-dyn/content/article/2010/08/07/AR2010080702087.html
[18] http://www.latimes.com/business/la-fi-fake-apples-20110207,0.4342503.story

18. ACTIVITY-BASED NAVIGATION

INTRODUCTION

The Global Positioning System (GPS) has become an integral part of how people navigate the world since it was made available for civilian use in the 1980s. GPS, "...a satellite-based navigation system made up of a network of 24 satellites placed into orbit by the U.S. Department of Defense," has no subscription fees or setup charges and can be used around the clock to aid navigation among travel destinations in all weather conditions anywhere in the world.[1] For the most part, GPS is a reliable way for people to map their way from location-to-location, but there are places where GPS signals are unavailable such as the inside of a building. Microsoft researchers are currently working on a technology, termed the Menlo Project, which is intended to function in places where GPS cannot.

BACKGROUND

Activity-based navigation is based on the use of human activity derived from sensor data to help a user navigate and retrace a path traversed by themselves or another person. Trails can include, "...step counts, walking up/down stairs or taking elevators, compass directions, and photos taken along a user's path, in addition to absolute positioning (GPS and maps) when available." This form of navigation is an alternative to the traditional map-based routing used in GPS road map systems and indoor localization systems, as activity-based navigation does not require the creation of a map and it is not reliant on absolute positioning that may not be available in all situations. Presently, activity-based navigation can be used for activities such as locating a lost object such as a car or finding an acquaintance in a large concert hall, cinema, or sports arena. In the future, activity-based navigation may be useful for performing more broad navigation tasks.

Navigation based on human activity involves the guiding of a user to a specific destination through the use of an established path of human movement activities. These activities can include walking up a specific number of stairs or going up/down a particular number of floors. The pattern of these activities can be acquired through sensor data from a trail previously traveled by the same or a different user that possessed a mobile device with sensors to track movement. Mobile tracking devices, such as Microsoft's Menlo, can intuitively infer and record a trail of activities based on sensor data gathered when a user walks, thus garnering a path without any assistance from the user. One of the advantages of activity-based navigation over a positioning-based navigation system like GPS is that it does not require pre-existing knowledge like a map or 3D building model. One of activity-based navigation's greatest assets is that it can serve as a useful tool for navigating spaces where GPS is not available.[2]

MICROSOFT MENLO

Microsoft is in the process of designing a mobile device that can collect trail data while a user walks indoors, underground, and in other spaces where GPS signals are not available or are too weak to be picked up like multi-level parking garages. The device would essentially facilitate the gathering of data used to create of a path of "digital bread crumbs". Comprised of a collection of sensors including, "an accelerometer to detect movement, a side-mounted compass to determine direction, and a barometric pressure sensor to track changes in altitude," the Menlo prototype phone is Microsoft's solution for users that need to navigate spaces that are incompatible with GPS.[3]

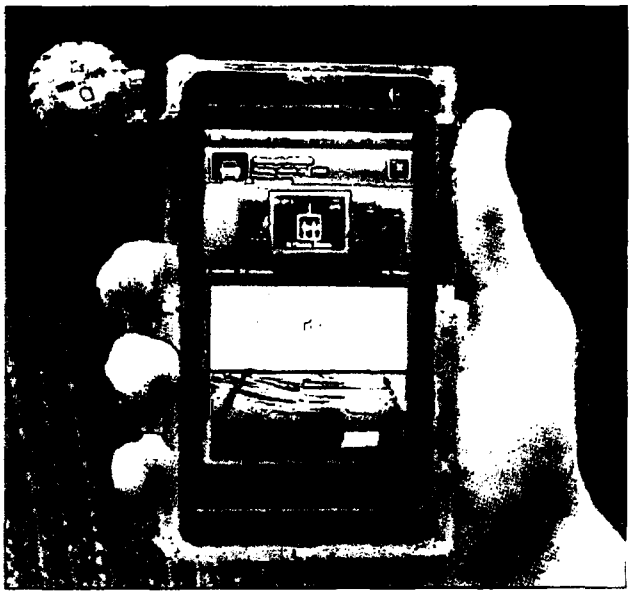


Figure 18-1 Microsoft Menlo Prototype[4]

Greenfield App

Several existing phones already have the sensors contained in Microsoft's prototype, although, Menlo also includes the Greenfield app, which works by harnessing data from its multiple sensors. The purpose of the Greenfield app is

[1] http://www8.garmin.com/aboutGPS/
[2] http://research.microsoft.com/pubs/121932/activitybasednavigation%20mobilehci2010.pdf
[3] http://www.technologyreview.com/communications/26079/page1/
[4] http://research.microsoft.com/pubs/121932/activitybasednavigation%20mobilehci2010.pdf

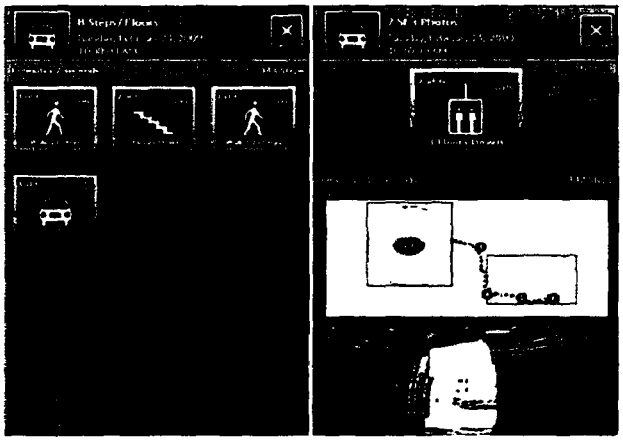


Figure 18-2 Greenfield User Interface

to, "...count a user's sequence of steps, gauge direction changes, and even calculate how many floors the user has traversed by stairs or an elevator." The Greenfield app can also store trail data so that a user can access and accurately retrace their path at a later time. The Greenfield app is considered a type of activity-based navigation and is being presented as a useful method for navigating locations where maps are inaccessible or have yet to be produced.

Uses for the Greenfield App

There are a number potential uses for the Greenfield app with Microsoft's Menlo. It is believed that, "Greenfield could be used for new kinds of urban street games, to recover lost items, to find friends at a stadium, or to rescue hikers and mountain climbers." It could act as a compass in common situations, like when a person leaves the mall after shopping for several hours and forgets where they parked their vehicle. With a Menlo phone running the Greenfield app, losing one's car is no longer a problem because the device has the capability to record a user's activity trail, allowing them to retrace their route. The device may also enhance trail data with pictures taken along the course of the user's path.

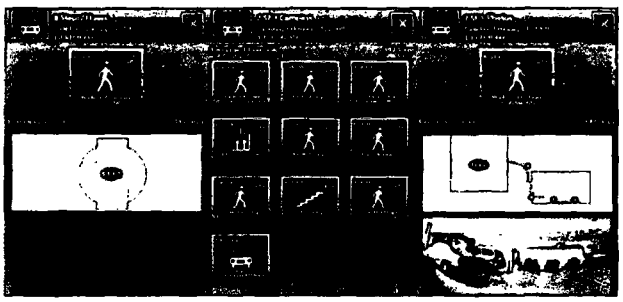


Figure 18-3 Greenfield App Conditions[5]

LAW ENFORCEMENT IMPACT

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"This kind of data is terrific for convicting people and terrific at exonerating people."

With an activity-based navigation device,

Since trail data can be obtained in areas where GPS would not normally be available, the Menlo prototype and the Greenfield app

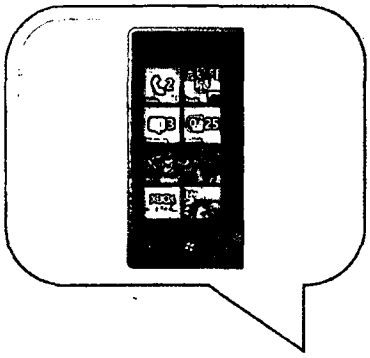
Should these devices become popular and used by targets, they will provide

GEOFENCING PATENT AWARDED TO WHERE, INC.[7]

On December 7, 2010, location based service and media company, Where Inc., was awarded a broad patent for geofencing technology. Patent number 7,848,765, in the works for more than five years, covers Where's method and systems for geofencing and the associated delivery of applications, content, and mobile coupons. A geofence is a user-defined virtual perimeter for a geographic area. Geofencing technology is already spurring the next wave of innovation around location services. Mobile applications and services are applying geofencing technology to enable users to send and receive notifications based on their exact whereabouts. Therefore, this patent is likely to affect a myriad of companies offering geofencing services, where the Eye-Fi Server writes to the EXIF

[5] Images from: http://research.microsoft.com/pubs/121932/activitybasednavigation%20mobilehci2010.pdf
[6] http://www.technologyreview.com/communications/26079/page1/
[7] http://mashable.com/2010/12/22/geofencing-technology-patent/

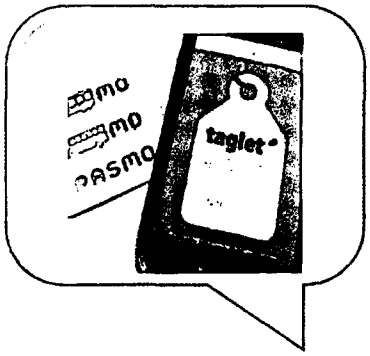
19. TECH BYTES



WINDOWS PHONE 7

Comes with a solid OS and strikes a balance between Web-oriented and local storage, using the cloud for information like contacts and apps and tying itself to a PC (or Mac, with a basic client) for big updates, music, and video syncing. Contacts from Facebook and Google sync and integrate perfectly, and finding your lost phone, photo uploading, and note syncing is built-in, automatic, and free.

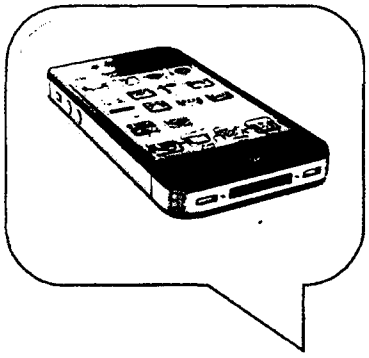
[1] http://gizmodo.com/5668738/windows-phone-7-review



APPS TURN SMARTPHONES INTO WALLETS

The first Android Gingerbread apps supporting NFC technology have already sprung up, even though there's just one compatible handset - Samsung's Nexus S. Two of these apps are Taglet, an information-sharing system that allows phones to pass details to each other with a swipe, and EnableTable, which plants NFC chips inside restaurant menus. Other mobile companies are on the brink of launching handsets supporting NFC including Nokia and RIM.

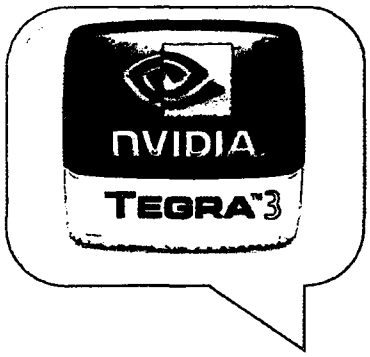
[4] http://www.technologyreview.com/communications/27125/?p1=A2



IPHONE 4 COMES TO VERIZON

Verizon's CDMA network doesn't support simultaneous voice and data like the GSM version. The big innovation is the five user Wi-Fi hotspot functionality, something that's standard on Android phones.

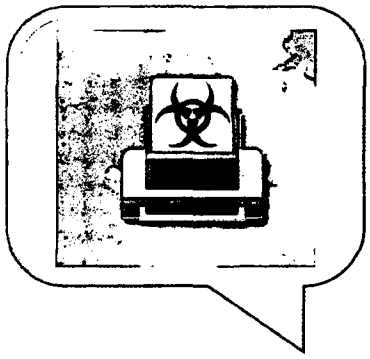
[2] http://www.engadget.com/apple/verizon-iphone/



SMARTPHONES AND TABLETS TO GET EVEN FASTER WITH NVIDIA'S TEGRA 3 CHIP

Nvidia is set to roll out the next-generation Tegra 3 chip for smartphones and tablets, promising to be even faster than its current processor, the dual-core Tegra 2. The new chip is expected to have four cores inside, which can further speed up browsing and gaming on tablets and smartphones. In addition, multiple cores can run at half speed to accomplish the same tasks that a single core would need to run at full speed, enhancing battery efficiency and generating less heat. Clearly, multicore smartphones have arrived, with quad-core chips probably waiting in the wings.

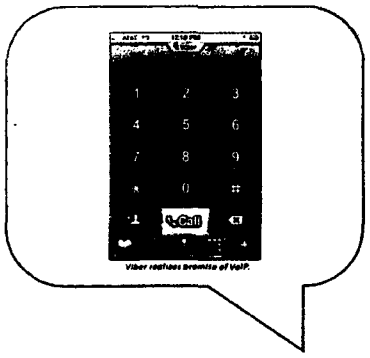
[5] http://mashable.com/2011/01/21/nvidia-tegra-3/



GIVING HACKERS A PRINTED INVITATION

Real attackers can mine printers for valuable information sitting inside the device. PrintFS automatically finds vulnerable printers via the Internet or in an internal network and turns them into a distributed storage network. Storage space could be used by hackers to store malicious programs or other material. According to an independent researcher, "Depending on the devices, most of the time, you can find 20 to 30 unsecured devices [on a local network] and you can get a gig of storage to 30 gigs of storage."

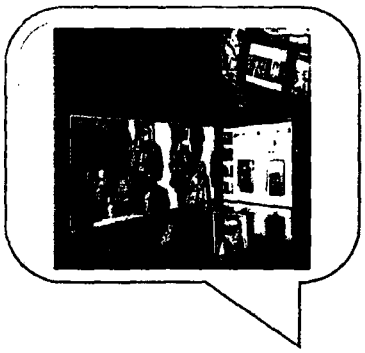
[3] http://www.technologyreview.com/computing/27121/page1/

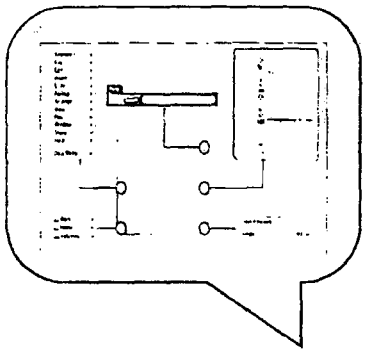


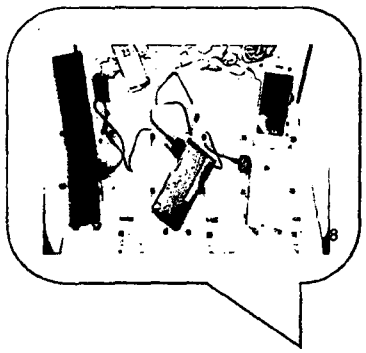
VIBER

Viber features deep integration with your native contacts, excellent call quality, and no registration. There's no assigned number and those that you call will see your own mobile number. Hit the purple icon instead of the green icon every time a phone call is made.

[6] http://www.wirelessweek.com/Reviews/2010/12/Mobile-Content-Out-with-Old-in-with-New-Mobile-Applications/







FACEVACS-VIDEOSCAN

FaceVACS-VideoScan automatically scans incoming video streams, detects multiple faces, and checks for possible "watch list" matches. If a match is found, operators are notified - in real-time - allowing them to focus on the identified person instead of simultaneously observing multiple video screens. The Cognitec facial-recognition system is used to continuously scan a crowd. The goal is to identify targeted individuals whose faces have already been captured as a digital image and stored in the facial-recognition system. When FaceVacs picks up a face that it recognizes through a facial biometrics match, it immediately pulls up the recorded face image and displays it with the live camera image of the scanned crowd.

[7] http://www.cognitec-systems.de/FaceVACS-Alert.20.0.html

MAGIC TRACKPAD

Make your Magic Trackpad act like a multi-button mouse with the BetterTouchTool.

The BetterTouchTool utility allows you to define your own gestures and actions. In addition to its not-yet-final support for the Magic Trackpad, BetterTouchTool works with many third-party trackpads and Apple's Magic Mouse. It even lets you assign various actions to keyboard shortcuts. The key feature is the ability to assign actions to newly-available gestures. This allows the user to replicate the functionality of the multi-button mouse while gaining the gesture features of the Magic Trackpad.

[8] http://www.macworld.com/article/157058/2011/01/trackpadtricks.html

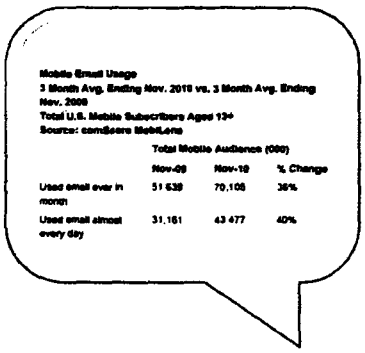
ASIAN CELLPHONES

When it comes to cell phones, America is still trying to catch-up with countries such as Japan and Korea.

Asians use their cell phones in more robust ways than the typical U.S. resident – as TVs, wallets, GPS devices, and music players. Japanese cell phones can double as a house key, a credit card, and an ID. Other cellphone functions include:

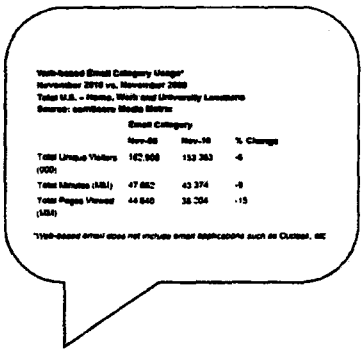
- Reads Vital Signs
- Environmental Awareness
- Home Security Service
- Internal Wi-Fi Spot
- Send Money to Other Subscribers
- Phones as Payment Systems
- Free TV on the Phone
- Barcode Reader
- Investigative Visits
- Personal Butler

[9] http://www.technewsdaily.com/10-cool-asian-cell-phones-features-you-cant-have-yet-0205/



Mobile Email Usage
3 Month Avg. Ending Nov. 2010 vs. 3 Month Avg. Ending Nov. 2009
Total U.S. Mobile Subscribers Ages 13+
Source: comScore MobiLens

	Total Mobile Audience (000)		
	Nov-09	Nov-10	% Change
Used email over in month	51 638	70,108	36%
Used email almost every day	31,161	43 477	40%



Web-based Email Category Usage*
November 2010 vs. November 2009
Total U.S. - Home, Work and University Locations
Source: comScore Media Metrix

	Email Category		
	Nov-09	Nov-10	% Change
Total Unique Visitors (000)	162,966	153 363	-6
Total Minutes (MM)	47 882	43 374	-9
Total Pages Viewed (MM)	44 840	38 204	-15

*Web-based email does not include email applications such as Outlook, etc

MOBILE E-MAIL RISES; WEB E-MAIL DIPS

Mobile e-mail is growing in popularity while the use of Web-based e-mail seems to be waning, according to a new study from ComScore. Looking back at November 2010, ComScore found that the number of people sending e-mail via a dedicated client on a mobile device was up 36 percent from the prior November. Over the same period, the number of visitors to Web-based e-mail sites fell by six percent. "From PCs to mobile devices, whether it's e-mail, social media, IM, or texting, consumers have many ways to communicate and can do so at any time and in any place."

[10] http://news.cnet.com/8301-1035_3-20029179-94.html?tag=mncol;txt

20. PATENTS OF INTEREST

LOCATION-BASED SERVICES

United States Patent Application 7,848,765
Abstract December 7, 2010

Provided herein are methods and systems relating to location-based services such as social networking, providing demographic information, tracking mobile devices, providing business information, providing an adaptable user interface, remotely effecting a change on a portable electronic device, providing a geo-fence, outputting location-based information on a mobile device, varying transmissions to and from a mobile device, providing location-based alerts, verifying transactions and tailoring information to the behavior of a user.

EXCLUSIVE WIRELESS SERVICE PROPOSALS

United States Patent Application 7,853,244 **Abstract December 14, 2010**

Provided herein are systems and methods for providing exclusive wireless service proposals to subscribers. A method for providing an exclusive wireless service proposal to a subscriber includes the steps of conducting measurements of at least one metric; sending measurement data acquired during the step of conducting to a measurement analysis machine (MAM), the MAM being configured to analyze the measurement data; analyzing the measurement data; predicting performance of at least one of wireless voice and wireless data services based upon the results of the analysis step; generating a proposal for exclusive wireless services based upon the measurement data and the performance prediction; and providing the proposal to a subscriber. Systems for performing this and additional or alternative methods are also disclosed.

CONTROLLING A DOCUMENT BASED ON USER BEHAVIORAL SIGNALS DETECTED FROM A 3D CAPTURED IMAGE STREAM

United States Patent Application 7,877,706 **Abstract January 25, 2011**

A computer-implemented method, system, and program product comprises a behavior processing system for capturing a three-dimensional movement of a user within a particular environment, wherein the three-dimensional movement is determined by using at least one image capture device aimed at the user. The behavior processing system identifies a three-dimensional object properties stream using the captured movement. The behavior processing system identifies a particular defined behavior of the user from the three-dimensional object properties stream by comparing the identified three-dimensional object properties stream with multiple behavior definitions each representing a separate behavioral signal for directing control of the document. A document control system selects at least one document element to represent the at least one particular defined behavior and inserts the selected document element into the document.

21. GLOSSARY

3GPP: Third Generation Partnership Project

AGPS: Assisted Global Positioning System

AMPS: Advanced Mobile Phone System

AMR: Adaptive Multi-Rate compression

API: Application Programming Interface

ARPU: Average Revenue Per User

AS: Application Server

BGCF: Breakout Gateway Control Function

BIP: Bearer Independent Protocol

BTS: Base Transceiver Station

CAGR: Compound Annual Growth Rate

CAMEL: Customized Applications for Mobile Enhanced Logic

CAPEX: Capital Expenses

CSoPS: Circuit-Switched over Packet-Switched

CDM: Code Division Multiplexing

CN: Control Network

CPE: Customer premise Equipment

CS: Circuit-Switched

CSFB: CS-Fallback

CTM: Cellular Text Modem

DCH: Dedicated Channel

DCS: Digital Cellular System

E-CSCF: Emergency Call Session Control Function

EDGE: Enhanced Data for GSM Evolution

eNB: Enhanced Node B

ENUM: Telephone Number Mapping from E.164 NUmber Mapping

EPC: Evolved Packet Core; also known as SAE (refers to flatter-IP core network)

EPS: Evolved Packet System is the combination of the **EPC/SAE:** (refers to flatter-IP core network) and the LTE/E-UTRAN

ETSI: European Telecommunication Standards Institute

EUTRA: Evolved Universal Terrestrial Radio Access

E-UTRAN: Evolved Universal Terrestrial Radio Access Network (based on OFDMA)

EV-DO: Evolution Data Optimized or Data Only

FCAPS: Fault, Configuration, Accounting, Performance & Security

FDD: Frequency Division Duplex

FDM: Frequency Division Multiplex

FDMA: Frequency Division Multiple Access

FDS: Frequency Diverse Scheduling

FMC: Fixed Mobile Convergence

GAN: Generic Access Network

GANC: Generic Access Network Controller

GBR: Guaranteed Bit Rate

GERAN: GSM EDGE Radio Access Network

GGSN: Gateway GPRS Support Node

GPRS: General Packet Radio System

GRE: Generic Routing Encapsulation

GSM: Global System for Mobile communications

GTP: GPRS Tunneling Protocol

GTP-U: The part of GTP used for transfer of user data

GTT: Global Text Telephony

GW: Gateway

HLR: Home Location Register

HO: HandOverPage 38 HPLMN Home PLMN

HPCRF: Home PCRF

HSDPA: High Speed Downlink Packet Access

HSPA: High Speed Packet Access (HSDPA + HSUPA)

HSPA+: High Speed Packet Access Plus (also known as HSPA Evolution or Evolved HSPA)

HSS: Home Subscriber Server

HSUPA: High Speed Uplink Packet Access

HTML: Hyper-Text Markup Language

HTTP: Hyper Text Transfer Protocol

HTTPS: Hyper Text Transfer Protocol Secure

IMEI: International Mobile Equipment Identity

IMPI: IMS Private Identity

IMPU: IMS Public Identity

IPTV: Internet Protocol TV

IPV4: Internet Protocol Version 4

IPV6: Internet Protocol Version 6

I-RAT: Inter-Radio Access Technology

ICS: IMS Centralized Services

IM: Instant Messaging

IM-MGW: IMS Media GateWay

IMS IP: Multimedia Subsystem

IN: Intelligent Networking

IP: nternet Protocol

IP-CAN: Internet Protocol Connectivity Access Network

IPSec: Internet Protocol Security

ISIM IP: Multimedia Services Identity Module

ISR: Idle Mode Signaling Reduction

ITU: International Telecommunication Union

kHz: Kilohertz

LCS: LoCation Service

LI: Lawful Intercept

LNA: Low Noise Amplifier

LNP: Local Number Portability (for North America)

LTE: Long Term Evolution

MAC: Media Access Control

Mbps: Megabitz per Second

MF: Multi-Frequency

MGCF: Media Gateway Control Function

MHz: Megahertz

MIM: Mobile Instant Messaging

MIMO: Multiple-Input Multiple-Output

MIB: Master Information Block

MIP: Mobile IP

MMS: Multimedia Messaging Service

MMTel: Multimedia Telephony

MRFC: Multimedia Resource Function Controller

MRFP: Multimedia Resource Function Processor

MMD: Multimedia Domain

MME: Mobility Management Entity

MMS: Multimedia Messaging Service

ms: Milliseconds

MSC: Mobile Switching Center

NAT-PT: Network Address Translation – Protocol Translation

OFDMA: Orthogonal Frequency Division Multiplexing Access (air interface)

OA&M: Operations, Administration and Management

OMA: Open Mobile ArchitecturePage 39

OP: Organizational Partner

OPEX: Operating Expenses

OR: Optimal Routing

OS: Operating System

OTA: Over-the-Air Activation

P-CSCF: Proxy-Call Session Control Function

P-GW: PDN Gateway

PCC: Policy and Charging Convergence

PCS: Personal Communication Service

PCRF: Policy Charging and Rules Function

PDN: Packet Date Network

PDP: Packet Data Protocol

PIM: Passive Iner-Modulation

PLMN: Public Land Mobile Network

PS: Packet-Switched

PSAP: Public Safety Answering Point

QoE: Quality of Experience

QoS: Quality of Service

RA: Routing Area

RAU: Routing Area Update

RAN: Radio Access Network

RAT: Radio Access Technology

RB: Radio Bearer

REL-X: Release '99, Release 4, Release 5, etc. from 3GPP standardization

RF: Radio Frequency

RIT: Radio Interface Technology

RLT: Release Link Trunk

S-CSCF: Serving- Call Session Control Function

S-GW: Serving Gateway (LTE)

SAE: System Architecture Evolution also known as Evolved Packet System (EPS) Architecture (refers to flatter-IP core network)

SCC AS: Service Centralization Continuity Application Server

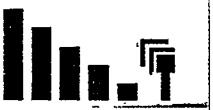
SGs: Reference point between the MME and the MSC for CS Fall Back

SGSN: Serving GPRS Support Node

SIM: Subscriber Identity Module

SIP: Session Initiated Protocol

SLR: Subscriber Location Register



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SMS: Short Message Service

SNS: Social Networking Site

SOA: Service-Oriented Architecture

SON: Self Opitmizing Networks

SRIT: Set of Radio Interface Technologies

SRVCC: Single Radio Voice Call Continuity

SV interface: Interface between the MME and MSC for performing SRVCC Handover

TA: Tracking Area

TAU: Tracking Area Update

TB: Transport Blocks

TCP-IP: Transmission Control Protocol/Internet Protocol

TDD: Time Division Duplex ~~ Telecommunication Device for Deaf

TDM: Time Division Multiplexing

TDMA: Time Division Multiplexing Access

TISPAN: Telecoms & Internet converged Services & Protocols for Advanced Networks, a standardization body of ETSI

TP: Transport Protocol

TrFO: Transcoder Free OperationPage 40

TS: Technical Specification

TSM: Transport Synchronous Module

TTY: TeleTYpe writer

UDI: Unrestricted Digitial Information

UE: User Equipment

UGC: User Generated Content

UICC: Universal Identifier Cryptographic Computer

UL: Uplink

UL-SCH: Uplink Shared Channel

UM: Unacknowledged Mode

UMA: Unlicensed Mobile Access

UMB: Ultra Mobile Broadband

UMTS: Universal Mobile Telecommunication System, also known as WCDMA

UpPTS: Uplink Pilot Time Slot

USB: Universal Serial Bus

USIM: UMTS SIM

USSD: Unstructured Supplementary Service Data

UTRA: Universal Terrestrial Radio Access

UTRAN: UMTS Terrestrial Radio Access Network

VANC: VoLGA Access Network Controller

VCC: Voice Call Continuity

VoIP: Voice over Internet Protocol

VoLGA: Voice over LTE via Generic Access

VPCRF: Visiting PCRF

WCDMA: Wideband Code Division Multiple Access

Continued from page 1

In August 2000, Mr. Bryars was assigned as a Supervisor to the Nashville Resident Agency, and was responsible for the Violent Crimes Safe Streets Task Force and supervised all FBI programs and personnel in three Resident Agencies in the territory surrounding Nashville. In 2005, as the Supervisor of the Nashville Joint Terrorism Task Force, he collaborated with the Tennessee Office of Homeland Security and state and local law enforcement to establish the state's first intelligence fusion center.

In February 2006, Mr. Bryars became the Assistant Special Agent in Charge (ASAC) for the Birmingham Division with responsibility for all criminal programs and Resident Agencies in the Northern District of Alabama. As the ASAC, he served as an On-Scene Commander for Major Case 235, overseeing the North Alabama Church Arson Task Force that investigated a series of rural church arsons. He worked with state and local police departments to coordinate and oversee Operation Clean Sweep, a collaborative effort with over 40 different agencies, resulting in over 350 arrests. In 2007, Mr. Bryars led the integration of the FBI's intelligence program throughout the Birmingham Division.

Prior to his employment with the FBI, Mr. Bryars worked as a Mechanical Engineer in the nuclear power industry. He is married and has two children.

22. TECH INSIGHTS

GOOGLE LAUNCHES VOICE-TO-TWITTER SERVICE TO HELP PROTESTERS IN EGYPT[1]

A group of engineers from Google, Twitter, and SayNow (which Google acquired) were hard at work building a speak-to-tweet service for protesters in Egypt. The service, which is already live, enables users to send tweets using a voice connection. Anyone can tweet by leaving a voicemail on one of three international phone numbers: +16504194196 or +390662207294 or +97316199855. Tweets sent using the service will automatically include the hashtag #egypt.

G.722 VOICE CODER

G.722 describes the characteristics of a wideband audio (50 to 7,000 Hz) coding system which may be used for a variety of higher quality speech applications including HD VoIP. The coding system uses sub-band adaptive differential pulse code modulation (SB-ADPCM) within a bit rate of 64 kbps. The system is referred as 64 Kilobits per second (Kbps)/(7 kHz) audio coding.

G.722 is Wideband Audio. The G.722 codec gives much better audio quality than G.711, typically the standard codec used on LANs and T-1/E-1 Circuits. Now users can have better than toll quality audio on an IP phone system at around 64 Kbps, the same bandwidth requirements as G.711. G.722 samples at 16 kHz instead of 8 kHz of G.711 resulting in much better audio quality. G.722 is an International Telecommunication Union standard.

Although the wireless 802.11n standard has just recently been made official, IEEE has begun work on the next iteration of Wi-Fi. The coming upgrade may deliver speeds of up to 1 Gigabit per second (Gbps) by improving on the effeciency of existing technology. The IEEE 802.11ac standard, set to be in draft form by 2011, will mainly work with the current technology powering 802.11a. The new standard will continue to work on the 5.0 GHz band, but will provide larger channels for data throughput. Whereas current technology uses 20 MHz-wide channels, 802.11ac will be using either 40 MHz or 80 MHz-wide (and possibly 160 MHz) channels to deliver data. Files will be able to flow more freely on your home network come 2012.

None of these specs are standardized as yet and they may be drastically change in the next few years. On top of that, a fatter pipe for wireless data throughput does not increase our actual Internet connection speeds. For most home users, the relevancy of 802.11ac may depend on the expansion of robust fiber optic Internet infrastructure or an increase in large-file data streaming.[2]

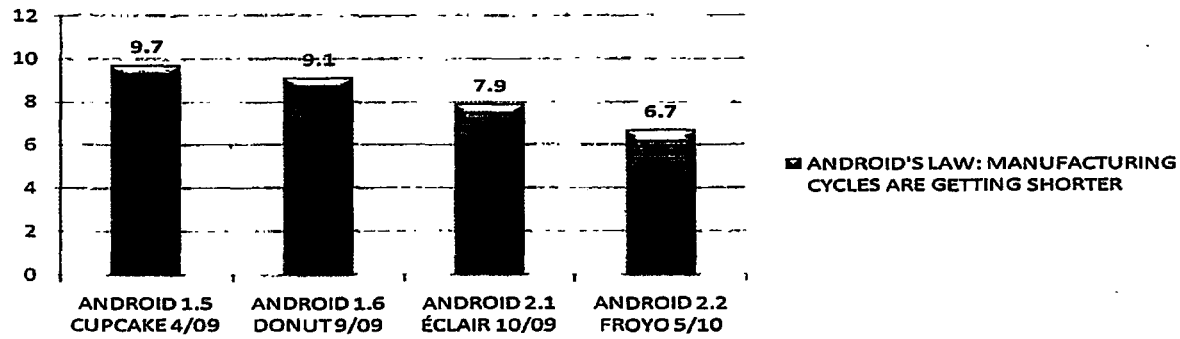
"The goal of 802.11ac is to provide data speeds much faster than 802.11n, with speeds around 1 Gbps. The timeline for 802.11ac approval is to have a draft standard created by 2011 and the first 802.11ac products out by the end of 2012. The technology behind 802.11ac has not been finalized. However, it will likely involve bonding four or eight channels together with some tweaks to the modulation scheme."[3]

802.11ac, slated to be the next release version of the Wi-Fi standard, hopes use advanced simultaneous transmission technology to increase data rates to 1 Gbps.

NOKIA TRANSITIONS TO MICROSOFT MOBILE OS

Nokia, the world's largest-volume cell phone maker, and software giant Microsoft are joining forces. Nokia will adopt Windows Phone as its choice smartphone platform and provide services (e.g., mapping programs), and Bing will become the default search engine.[4]

ANDROID'S LAW: MANUFACTURING CYCLES ARE GETTING SHORTER[5]

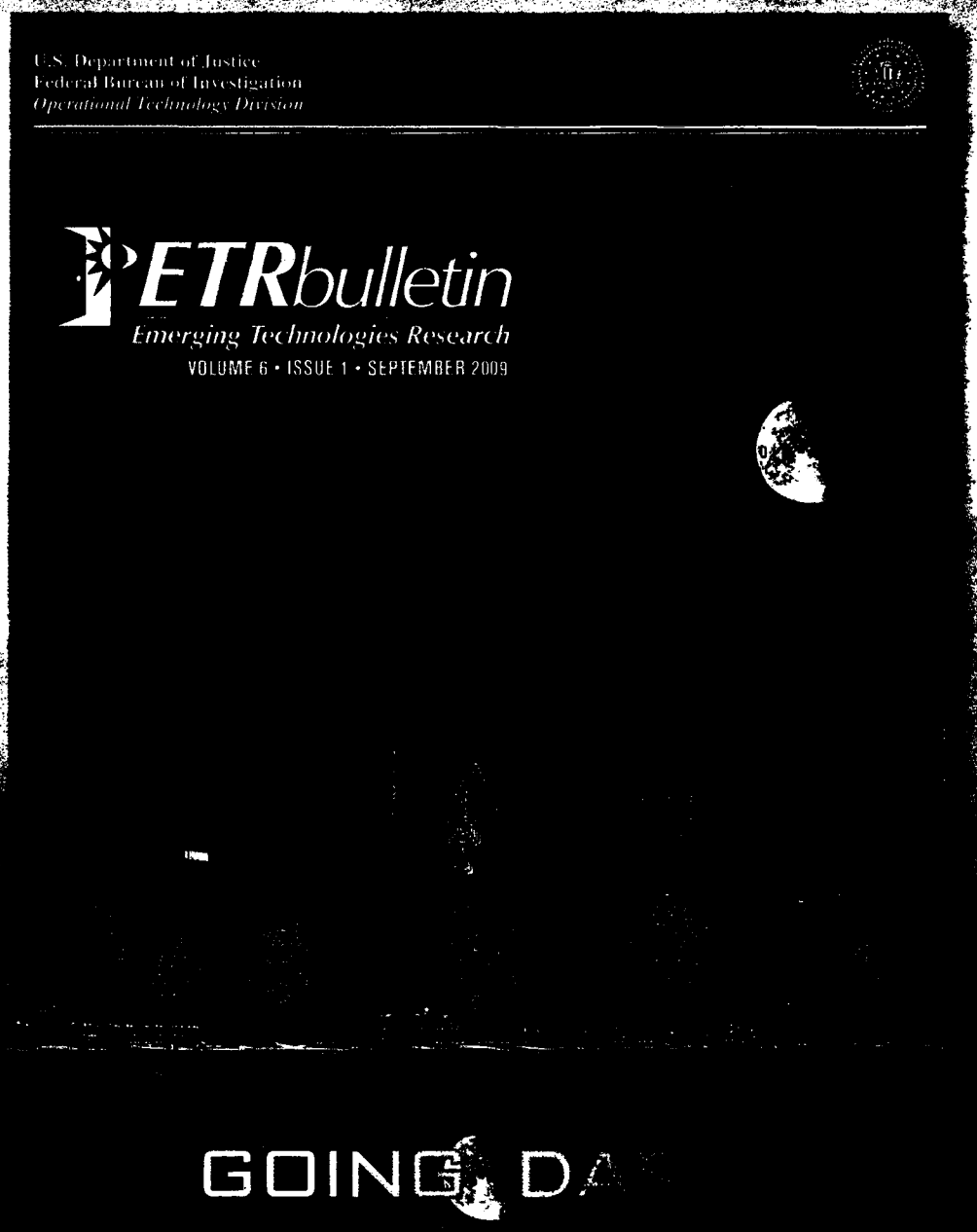


[1] http://mashable.com/2011/01/31/google-twitter-egypt-call-service/
[2] http://www.pcworld.com/article/184067/80211ac_standard_will_bring_gigabit_speeds_to_wifi.html
[3] http://www.aksgeek.com/2011/02/zero-to-billion-80211ac-enabled-device.html#xzz1DOKhaSaj
[4] http://www.cnn.com/2011/TECH/mobile/02/11/nokia.microsoft/index.html
[5] http://phandroid.com/2011/01/31/new-phone-already-feeling-old-you-can-thank-androids-short-manufacturing-cycle/25

GOING DA

"Our state and local partners face the same challenge. Much like our caseload, the majority of their cases include criminals using some form of electronic means to communicate. And because of this divide between technology and the law, they too are increasingly unable to access the information they need to protect public safety, and the evidence they need to bring criminals to justice."

FBI Director Robert S. Mueller, III's remarks at the National Security Preparedness Group Conference, Washington, D.C., October 6, 2010



The Emerging Technologies Research (ETR) Bulletin will include a permanent section devoted to the 'Going Dark' Initiative. Information pertaining to this Initiative will be highlighted and readers will be provided details concerning this significant effort. Your feedback is important to us and welcomed. We look forward to your comments and/or questions.

GOING DARK

b7E

A REVIEW OF THE NATIONAL LAWFUL INTERCEPT STRATEGY

EXECUTIVE SUMMARY

Court-authorized lawful interception is a critical tool necessary to enforce the law, protect our citizens, and maintain our Nation's security. Maintaining a capability to lawfully and properly intercept communications content and communications-identifying information pursuant to court order forms the very foundation of law enforcement's National Lawful Intercept Strategy. Equally important is the balance maintained by existing laws between the interests of our citizen's privacy, the communication industry's competitiveness, and law enforcement's duty to protect our nation's people.

As detailed in a recent ETR Bulletin[1], the variety and complexity of new communications technologies and services and the "convergence" of these technologies and services have increased dramatically over recent years.

Self-help has always been a first instinct for law enforcement, but law enforcement is at a point where enhanced communications industry help and additional funding are required. Hence, law enforcement has developed a five-pronged National Lawful Intercept Strategy:[2]

1. **Modernization Of Lawful Intercept Laws** - Reviewing current lawful intercept legislation, regulation, and assistance mandates, and identifying areas that need updating.
2. **Lawful Intercept Authorities** - Identifying impediments to law enforcement's ability to protect and share lawful intercept technical equipment and expertise.
3. **Enhanced Law Enforcement Coordination** - Enhancing greater law enforcement lawful intercept mutual coordination/assistance.
4. **Greater Industry/Law Enforcement Cooperation** - Expanding industry cooperation among law enforcement on new and emerging technology issues/ solutions.
5. **New Federal Resources** - New Federal funding to bolster lawful intercept capabilities.

The five components of the Strategy must be pursued in concert. Adopting one or more, but not all, of the prongs would be ineffective—that is, a partial fix is no fix. Consequently, the support of the Administration and the Congress is vitally important, especially with respect to the legislative and appropriations funding components.

IMPORTANCE OF LAWFUL INTERCEPTION

Lawful interception is critically important and is relied on in many significant investigations -- a fact attested to repeatedly. In the House Report of the Communications Assistance for Law Enforcement Act (CALEA) of 1994, it states, "Law enforcement officials have consistently testified, as Director Freeh did at the hearings of the bill, that court-authorized electronic surveillance is a critical law enforcement and public safety tool."[3] Further, lawful interception produces vital intelligence and singular evidence, leading to the prevention of major terrorist attacks and prosecution of the leadership of major organized crime families and drug-trafficking cartels.

Impediments to Lawful Intercept

- "Access" pertains to the first step in effecting lawful interception, where a service provider or law enforcement seeks to identify an intercept access point (IAP) to isolate the lawful intercept subject's communications in order to intercept it.
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[1] Emerging Technologies Bulletin, Volume 6 Issue 1, September 2009.
[2] For more detailed information regarding each of the five prongs, please refer to the Going Dark Edition of the ETR bulletin, published in September 2009.
[3] H.R. Rep. No. 103-827, at 17 (1994), reprinted in 1994 U.S.C.C.A.N. 3489, 3497.

[redacted] in turn, to needless additional lawful intercept costs. The proposed National Lawful Intercept Strategy, among other things, is intended to bring about carriers' implementation of standard commercial delivery formats and protocols.

- While communications protocols are employed in voice-based telecommunications, the use of numerous diverse communications protocols, especially by communications application providers, is dramatically greater in an electronic/data communications environment. For law enforcement, as well as for communications service and application providers and end-users, communications cannot be handled, processed, and understood if one cannot identify and understand the communications protocols involved. [redacted]
- Prior to CALEA, most law enforcement could conduct lawful interception in analog voice networks by using standard commercial intercept, collection, and recording equipment. There was very little need to "process" or "view" those intercepted voice communications. However, post-CALEA, more complex and much more expensive lawful intercept "collection systems" are now required in order to properly interface with the CALEA-grade voice intercept solutions fielded by carriers. Furthermore, with the growth in electronic communications, much more complex and sophisticated law enforcement multimedia (e.g., voice, email, and imagery) collection platforms are now required to process, present, and view intercepted communications. [redacted]
- Until the early 1990s, law enforcement lawful intercept capabilities were often limited to the installation of relatively inexpensive wiretap devices by technical personnel. But, with the communications revolution and the advent of digital and IP-based communications, [redacted] Accordingly, along with the cost impediments involved, [redacted]

[redacted]

As part of the National Strategy, a significant infusion of funding is sought to assist state/local law enforcement by increasing and leveraging national technical expertise, training, and assistance.

- Conducting lawful interception today with modern multimedia digital and IP services, applications, and networks is vastly more expensive than in the past. As a result of greatly increased costs, [redacted] The FBI increasingly has had to expend great sums in its lawful intercept program in order to cope with the technological challenges noted above. [redacted] But, to [redacted]

Countering Lawful Intercept Impediments – A National Lawful Intercept Strategy

To deal with existing and ever-emerging lawful intercept challenges, law enforcement has developed a five-pronged National Lawful Intercept Strategy. Drawing on existing lawful intercept expertise from the FBI and other lawful intercept leading agencies, a core purpose will be to coordinate, integrate, and distribute lawful intercept solutions among law enforcement, increasing their ability to strengthen lawful intercept capabilities and information sharing in a more effective and efficient way.

Any change in the current paradigm of lawful interception will likely require an extensive, coordinated effort on behalf of the entire law enforcement community. Future progress of the National Lawful Intercept Strategy will require Congressional hearings, testimony, and meetings with high-level decision makers. Success will hinge upon law enforcement's ability to clearly illustrate case examples of [redacted] each of the five prongs of the National Strategy will be needed. Finally, how law enforcement is capable of leveraging existing capabilities (i.e., sharing capabilities among agencies) to solve a case that would have otherwise gone unsolved will be instrumental.

[redacted]

INFOGRAPHIC: AT&T'S WI-FI CONNECTIONS

Wi-Fi is increasingly taking the burden off already strained cell networks, and recent numbers issued by AT&T show just how huge Wi-Fi usage has become.

In the third quarter of last year, users made 106.9 million connections on AT&T's U.S. Wi-Fi network. Q3 2010 connections were more than 320 percent higher.

The company's collective total value of signed Wi-Fi customer contracts is approximately $200 million. The company saw 228.1 million connections through the first nine months of 2010, and was estimated to break 300 million connections.

"In addition to smartphones, we saw that more devices like tablets, eReaders and netbooks were becoming Wi-Fi enabled and realized that Wi-Fi would play a major part in our ability to mobilize everything for our customers. Now, our Wi-Fi services are a significant asset for AT&T and for the consumers and businesses we serve."[1]

BROADBAND USAGE GROWING EVEN AS GAPS PERSIST[2]

The U.S. still faces a significant gap in residential broadband use that breaks down along incomes, education levels and other socio-economic factors, even as subscriptions among American households overall grew sevenfold between 2001 and 2009.

Key socio-economic characteristics in the U.S. continues to confront a racial gap in residential broadband use, with non-Hispanic white Americans and Asian-Americans more likely to go online using a high-speed connection than African-Americans and Hispanics.

Major Findings

- 94.1 percent of households with income exceeding $100,000 subscribed to broadband in 2009, compared with 35.8 percent of households with income of less than $25,000
- 84.5 percent of households with at least one college degree subscribed to broadband last year, compared with 28.8 percent of households without a high school degree
- 77.3 percent of Asian-American households and 68 percent of non-Hispanic white households subscribed to broadband last year, compared with 49.4 percent of African-American households and 47.9 percent of Hispanic households
- 65.9 percent of urban households subscribed to broadband in 2009, compared with 51 percent of rural households

CORPORATIONS GOING TOTALLY WIRELESS[3]

Mobile broadband services are becoming competitive with fixed data links—which means businesses should be able to cut their wired connections.

During the first wave of the wireless revolution, businesses realized that being out of the office didn't mean being out of action. BlackBerrys, iPhones, and 3G dongles for laptops let businesspeople stay connected on the move.

The second wave, ushered in by the development of 4G mobile broadband, will take the mobile revolution indoors. Cellular networks and other service providers are preparing services for offices that will make wired infrastructure such as desk phones and wired Internet links obsolete.

Verizon's Long Term Evolution (LTE) service, a set of standards for future networks, was launched at the end of 2010, bringing coverage to more than 100 million people. "We'll be announcing 4G modems first and support for cell phones by mid-2011." The firm isn't building a cell phone network but a data network, one just as fast as wired links.

Sprint Nextel rolled out its 4G service in major U.S. cities last year, and is now over 55 cities. That network is based on the WiMAX standard, an alternative to LTE. Sprint is also working on the idea of packaging a set of 4G modems and other hardware into an off-the-shelf "office in a box." "It would contain everything you needed to set up a new branch and connect it up." There are doubts that networks can keep pace with the demand for wireless data, a demand that's growing by 55 percent annually in North America.

Research firm Infinetics predicts that by 2013, there will be more North Americans connecting to the Internet via mobile broadband than via any other form of access—

[1] http://www.mobilemarketingwatch.com/infographic-atts-wi-fi-connections-in-q3-exceeded-total-for-all-of-2009-10567/#more-10567
[2] http://www.dailyfinance.com/article/broadband-usage-growing-even-as-gaps/1381657/
[3] http://technologyreview.com/printer_friendly_article.aspx?id=26636

with enterprises expected to account for much of the demand. The era of flat pricing for wireless data looks to be ending; the next step might involve asking customers to pay for different tiers of service depending on their data demands. Ultimately, net neutrality policy may become the biggest practical distinction between wired and wireless connections.

IPHONE KILLSWITCH PATENT

In a move that seems Big Brother-ish, Apple has a patent in the works that could use voice and facial recognition technology to activate a "kill switch" on its popular iPhone, shutting it down when hackers "jailbreak" or unlock the phone to install unauthorized programs on it, or try to steal information from an unsuspecting iPhone user.

Apple would track "suspicious behavior", including comparing the "identity of the current user to the identity of the owner of the electronic device," then notify the legal owner of the iPhone about the possible hack. There are some "scary" issues around the technology, including where data collected by Apple would stored, and who would have access to it. "Hopefully this would be entirely up to the consumer or user of the device whether or not they were going to buy into it at all. Apple's patent, "Systems and Methods for Identifying Unauthorized Users of an Electronic Device," was filed in February 2009, but published August 19th by the U.S. Patent & Trademark Office. The "kill switch" would be part of a processor that Apple would create.[4]

The ways a registered owner uses the iPhone and where it's used could also be obtained, Apple said. "For example, information such as the current's user's photograph, a voice recording of the current user, screenshots of the electronic device, key-logs the of electronic device, communication packets (e.g., Internet packets) served to the electronic device, location coordinates of the electronic device, or geo-tagged photos of the surrounding area can be gathered."

"Unauthorized users" could be detected, the company said, by monitoring, "activities such as entering an incorrect password a predetermined number of times in a row, hacking the electronic device, jail-breaking the electronic device, unlocking the electronic device, removing a SIM card from the electronic device, or moving a predetermined distance away from a synced device."

Apple is proposing that when an "unauthorized user is detected; various functions of the electronic device can be restricted. For example, access to particular applications and sensitive information can be restricted and erased from the electronic device."

The patent targets a number of behaviors such as compromising or hacking a device, including removing the SIM card, unlocking, jail-breaking, and even moving.a predetermined distance from a synced device.

The application also identifies a number of methodologies for determining whether a user is legitimate, including photographing the user and applying facial recognition software, analyzing their voice, and analyzing a users' heartbeat using a "heartbeat sensor"—which, so far doesn't exist in any current Apple product. In addition to potentially shutting down the device if unauthorized users are detected, the technology could also be used to wipe sensitive information—address books, email, passwords, account details, and sensitive text messages—if it detects an unauthorized user.[5]

SAMSUNG OFFERS SMARTPHONE USERS ISLAMIC APPS THIS RAMADAN[6]

Samsung Electronics Co., Ltd., a market leader and award-winning innovator in consumer electronics, announced the launch of a dozen customized Islamic apps for smartphones. The suite of applications includes a Prayer Time calculator that shows official prayer times in over 400 cities and the only mobile Quran that is certified by Al Azhar. The applications can be downloaded for free and can be used across a variety of mobile phone platforms including Android, and Samsung's own Bada operating system. The new applications are available to users of Android, Bada, and Java-based phones who can download them via shortcuts to the Samsung's App Store. Bada smartphone users can also download the applications directly from the App Store (www.samsungapps.com). Users with online access through Wi-Fi or 3G can also use the built-in RSS Readers on their Galaxy S and Wave handsets to update the Al Bayan application with the latest Islamic and regional news." The smartphone has become a ubiquitous part of day-to-day life and it seems only fitting that it plays an important role during the month of Ramadan," said the General Manager of Samsung Egypt. "Ramadan is the holiest month in the Islamic calendar and we are keen to offer our customers the added functionality of Islamic smartphone applications." The new range of applications includes:

[4] http://technolog.msnbc.msn.com/_news/2010/08/23/4954400-apple-would-use-voice-facial-recognition-as-part-of-iphone-kill-switch
[5] http://www.digitaltrends.com/mobile/apple-applies-for-iphone-killswitch-patent/
[6] http://www.zawya.com/printstory.cfm?storyid=ZAWYA20100829114836

- A Hijri calendar that integrates with the smartphone's calendar, and shows Islamic and national holidays
- A Prayer Time calculator that shows official prayer times in over 400 cities with multiple Adhan voices. The application also shows the position of the Qibla to the user
- A Mobile Quran application that is Al-Azhar certified and features popular Ottoman calligraphy
- An Al-Doaa application that shows Doaas and Ahadith Qudsaya organized by situation with comprehensive explanations of origins and benefits
- The Al-Sebha application which shows popular morning and nightly Tasabeeh with explanations
- An Al-Sunna application, which automatically indexes all Muhammed Sunnahs for different situations and explains the rewards of each Sunna
- The Al-Bayan application keeps users updated on the latest Islamic and regional news with regional and Islamic RSS feeds
- A Hajj & Umra Daily guide which features step-by-step explanations of all the rituals and deeds
- The Tazkerah application notifies users when and how many times to recite the Zikr while explaining the benefits and origins of each Zikr
- The 99 Names application shows the 99 Divine names in beautiful graphics accompanied with explanations of their meaning
- The Zakaty is an interactive Zakah calculator accompanied by explanations and Esnad
- The Ramadaniat application contains a full description of Ramadan activities

Currently, the applications can be downloaded and used on a variety of Samsung smartphones including the Galaxy S, Wave, and Java-based models like Champ (C3303K).

SYNCING SOCIAL NETWORKS

Managing your multiple different social network streams and accounts can be a time consuming task for some. A number of startups aim to help you publish to multiple social networks at the same time including Ping.fm and HelloTxt. GoGoStat Sync, a startup developed by a number of ex-Microsoft employees is hoping to make the syncing of social networks a bit easier today by allowing users to organize and update their profiles on Twitter, Facebook, MySpace, and Flickr.

On GoGoStat Sync, you can synchronize contacts and photos across multiple social media sites, publish status updates across sites, and sync address books with social networks and email accounts. One feature of the Sync app is that synchronization occurs in the background, not just when users are logged in. Synchronization can be defined in any direction, and users can set-up their Sync rules using credentials from any of their social media sites, so it is not necessary to set up different credentials for GoGoStat Sync.[7]

SocialShield, is a service designed to help parents keep their kids safe while using online social networks. "Since launching this summer, we've proven the technology works. SocialShield has identified suspicious friends, including a sex offender who had connected with a child on a social network, as well as helping one family with a suicidal teen after keywords were flagged in the child's stream." A cloud-based service, SocialShield has no software to download or install, and extracts information wherever Facebook, MySpace, or other social networks are being used, including cell phones.[8]

Group Texting, Going Beyond Mobile

Texting is not just for kids anymore. Thanks to iPhones, Blackberrys, and new mobile apps, it is possible to text a group of people at once, opening the world of text to the novice. Group texting is a great tool for personal collaboration. It can be used in almost every situation, from making plans to gathering opinions. Free smartphone apps like Fast Society (iPhone), textPlus 4 (Apple and Android devices), BrightKite (Apple, Android and BlackBerry), and GroupMe (iPhone and, next month, Android) are among the apps that have emerged, making it easier and smarter to group text.[9]

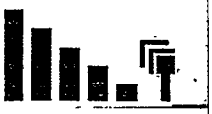
THE REALITY OF SOCIAL NETWORKING IN A WIRELESS AGE[10]

Facebook brings the Afghan War to Fort Campbell

With each successive year of war, new technologies and social-media sites have narrowed the distance between the home front and the frontlines. In the early days of the Afghan war - before Facebook existed - troops typically e-mailed home a few times a week or called with a lesser frequency.

Today, spouses and troops; based in even the most remote areas of Afghanistan, can trade messages and phone calls dozens of times a day. In good times, the minute-by-

[7] http://techcrunch.com/2010/04/12/gogostat-competes-with-ping-to-sync-your-social-networks/
[8] http://venturebeat.com/2010/10/05/socialshield-pulls-in-10m-to-help-parents-monitor-kids-social-networking/
[9] http://www.cmswire.com/cms/enterprise-20/mobile-enterprise-group-texting-going-beyond-mobile--009017.php
[10] http://www.washingtonpost.com/wp-dyn/content/article/2010/11/04/AR2010110407505_pf.html



minute status updates provide peace of mind.

A massive roadside bombing had killed five soldiers from her husband's 120-man infantry company. The soldier was calling Franks, who was at the center of a wives' support network, in violation of a military-imposed communications blackout on the unit.

Using an Afghan cellphone, he told Franks that her husband was safe, but that the company commander was probably dead.

The events 7,000 miles away in Afghanistan take on a different face when the windows of communications are temporarily closed or eliminated. The world of communications and the reliance on technology becomes abundantly clear when that resource is limited or non-existent. Living behind the scenes as part of a military family is a story that often goes untold and is brought to life when tragedy occurs and is broadcasted as the 'Breaking News' or comes across as a Really Simple Syndication (RSS) News Feed.

To ensure that a service member's family does not receive the news of a death by e-mail, phone, or an errant Facebook posting, the military temporarily shuts down Internet access to deployed units that suffer a fatality. In today's era of ever-present connections, such blackouts are rarely enough to cut off the flow of information.

When the news comes that something terrible has happened, social-media sites become sluggish with the number of users and text messages being sent at a rapid speed in a quest to get the latest update. Worried spouses search for news, post prayers on Facebook and they scour the Internet for scraps of information about the fate of their loved ones.

In moments of crisis, the connectivity can make the looming possibility of death seem almost suffocating. Spouses jump with each phone call and ringing doorbells spark tremors of terror.

The Army funnels information to the spouses of deployed soldiers through volunteer-run Family Readiness Groups, which evolved from now-defunct officer and enlisted wives clubs.

Many of the spouses were accustomed to getting calls from their husbands via cellphone and Skype in the morning. No one received a call on the morning of June 7. None of the soldiers were on Facebook. The unit was in blackout.

It was an agonizingly slow process. First the military had to track down the relatives of the deceased across the country. Then chaplains and officers trained to deliver the news drove to their doorsteps, a ritual that the military considers sacred.

She waited there until midnight, the hour at which the Army stops notifying next of kin of a fatality.

Then she went inside and logged onto Facebook.

News of his death hit Facebook before his wife was formally notified.

The Army relies on phone trees run by the wives to spread the word. Franks spent most of the day on the phone with spouses and parents. "First off your soldier is safe," she began. "However, I have some bad news I need to give you." At that point, Franks was supposed to read an official script listing the names of the dead before moving on to the next family.

As she was working through her call list, the blackout was lifted. Franks' husband, Michael, contacted her via a Skype video call from Afghanistan. He looked physically and emotionally drained.

WI-FI DIRECT

The Wi-Fi Alliance unveiled a new standard it hopes will make Wi-Fi the de facto standard for peer-to-peer wireless. Known as Wi-Fi Direct, it will turn any supporting device into an access point and let it auto-discover other compatible hardware nearby. The technique will not only simplify ad hoc networks, reducing the need for a dedicated router, but will let peripherals use Wi-Fi where they couldn't have before; cameras, mice and other devices could work without needing any special setup.[11]

Using Wi-Fi radios embedded in Wi-Fi Direct devices to form a connection between gadgets in the absence of a nearby hotspot or Internet connection, two or more individuals can share apps, play a video game together and more using Wi-Fi direct. Pictures can be wirelessly printed from a camera at a kiosk, or display smartphone pictures on a TV. For security reasons, a pair of devices will communicate with one another, similar to forming a connection between two Bluetooth devices. Press a button on the first device and the subsequent devices open a window asking for permission to connect to the primary device.[12]

Wi-Fi Direct is expected to be approved for new products

[11] http://www.electronista.com/articles/09/10/14/wi.fi.direct.standard.due.in.mid.2010/#ixzz15YB8gEbK
[12] http://content.usatoday.com/communities/technologylive/post/2010/10/wi-fi-direct-can-connect-devices-without-a-hotspot/1

by mid-2010, allowing devices to communicate with one another or other forms of hardware, or perform tasks like printing or sharing files. "Wi-Fi Direct represents a leap forward for our industry. Wi-Fi users worldwide will benefit from a single-technology solution to transfer content and share applications quickly and easily among devices, even when a Wi-Fi access point isn't available. The impact is that Wi-Fi will become even more pervasive and useful for consumers across the enterprise."[13] Devices that meet the alliance's specifications can use the Wi-Fi Certified logo on their products.

"Empowering devices to move content and share applications without having to join a network brings even more convenience and utility to Wi-Fi-enabled devices. The new Wi-Fi Direct standard is intended for both consumer electronics and enterprise applications. It will include WPA2 security, and management features for enterprise environments."[14]

ANALOG CODECS[15]

G.729 delivers call quality that is only marginally less than that of G.711 but uses approximately half the bandwidth. This offers very significant benefits as we move to fully IP based networks as it allows greater volumes of voice traffic to be carried. G.722 on the other hand uses a similar amount of bandwidth as G.711, but samples audio at 16 Kilohertz (kHz) which is double that of G.711 and delivers what many regard as far more natural sounding audio. Newer codecs such as Siren22, created by Polycom, take things a step further and sample audio at 22 kHz, resulting in audio that sounds even better but with the downside of using significantly more bandwidth. G722-2 or AMR-WB is also slowly making it's presence felt in the mobile market with a number of mobile carriers having recently deployed this codec, which offers superior 16 kHz voice quality over a mobile connection when the end users both have handsets that support this codec.

GSMA VOLTE[16]

The GSMA Voice over LTE (VoLTE) initiative was formally announced on February 15, 2010. In establishing the VoLTE initiative, GSMA has adopted the work of the One Voice Initiative* as the basis of the work to lead the global mobile industry towards a standard way of delivering voice and messaging services for Long-Term Evolution (LTE). Using IP Multimedia Subsystem specifications developed by 3GPP as its basis, GSMA expanded upon the original scope of One Voice work to address the entire end-to-end voice and SMS ecosystem by also focusing on Roaming and Interconnect interfaces, in addition to the interface between the customer and the network.

This is comprised of three sets of interfaces:

- The User Network interface (UNI) between the customer's equipment and the service provider's network
- The Roaming Network Network Interface (R-NNI) between the Home and Visited Network of a subscriber that is not attached to their normal Home network
- The Interconnect Network Network Interface (I-NNI) between the networks of the two parties making a call

TURN YOUR IPHONE INTO A FAKE WINDOWS PHONE 7 WITH THIS HACK[17]

Released as a public beta, a new hack transforms the interface of the iPhone to mimic the main screen of Windows Phone 7. The iPhone theme does not work the same. The authentic Windows Phone 7, uses tiles to represent "Hubs" containing the main experiences of the phone. The photo hub has a camera and after snapping a photo it brings up a feature to share the photo on social networks or via e-mail. This is called 'threaded' experiences. The iPhone hack does not replicate the threaded Hub functionality, it repurposes the individual apps into Windows Phone 7 like tiles and mimics the process of adding or removing tiles. Jailbreaking is required.

[13] http://www.appleinsider.com/articles/09/10/14/apple_endorses_wi_fi_direct_for_networking_without_hotspots.html
[14] Ibid
[15] http://www.vocal.com/speech_coders/g722.html
[16] http://www.gsmworld.com
[17] http://www.wired.com/gadgetlab/2011/01/windows-phone-7-hack/

802.11ac[1]

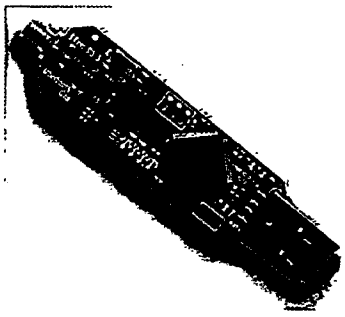
Although the wireless 802.11n standard has just recently been made official, IEEE has begun work on the next iteration of Wi-Fi. The coming upgrade may deliver speeds of up to 1 Gigabit per second by improving the effeciency of existing technology.

The IEEE 802.11ac standard, set to be in draft form by 2011, will mainly work with the current technology powering 802.11a. The new standard will continue to work on the 5.0 GHz band, but will provide larger channels for data throughput. Whereas current technology uses 20 MHz-wide channels, 802.11ac will be using either 40 MHz or 80 MHz-wide (and possibly 160 MHz) channels to deliver data. Files will be able to flow more freely on your home network come 2012.

None of these specs are standardized as of yet and they may be drastically changed in the next few years. On top of that, a fatter pipe for wireless data throughput does not increase our actual Internet connection speeds. For most home users, the relevancy of 802.11ac may depend on the expansion of robust fiber optic Internet infrastructure or an increase in large file data streaming.

UBERTOOTH ONE: A BLUETOOTH NETWORK HACKING TOOL ON KICKSTARTER[2]

Ubertooth One is a cheap, open-source Bluetooth network sniffer. Unlike Wi-Fi, which has had a wide range of free network monitoring tools for years, Bluetooth has remained pretty closed. This is about to change with the Ubertooth Kickstarter project.



The Ubertooth One is a USB plug with an antenna, and ARM Cortex-M3 processor-based board in-between. Plug it into your computer and you can use it with various wireless monitoring tools like Kismet. The Ubertooth allows you to use Bluetooth in monitoring mode. This "promiscuous" mode makes the radio pass everything that it picks up onto the host computer. Normally, wireless receivers will ignore anything not addressed to them. In "promiscuous" mode, you can sniff and gather data meant for other devices.

These tools can be used for testing network security, or for hacking. Kismet, for example (and derivatives like the Mac OS X version KisMac) can be used to crack Wi-Fi networks' passwords.

Until now, Bluetooth monitoring hardware would cost upwards of $1,000. This device will cost just $100, and because both the software and hardware are open-source, you can build your own.

ANONYMOUS CREDENTIALS[3]

Anonymous credential systems allow users to authenticate themselves in a privacy preserving manner. In a credential system, a user can obtain credentials from an organization, and then at some point later on prove to the organization (or any other party) that they have been given appropriate credentials. In an anonymous credential system, user can do this without revealing anything else about their identity. In fact, we can even guarantee that if the user credentials are used a second time, no one will be able to tell that the two interactions involved the same user. Not only is it impossible to identify the user; there will be no way anyone can trace the user's transactions.

Research has focused primarily on using new developments in proof systems (such as the pairing based constructions of Groth, Ostrovsky, and Sahai) to design credential schemes which rely on weaker assumptions, allow users to perform a wider range of transactions anonymously, or prevent users from abusing their privileges.

SPRINT'S 4G STRATEGY[4]

Sprint's long-term 4G strategy to be presented later this year, indicates that Sprint might adopt the LTE technology that everyone else is using, and ditch WiMax, which no one else is using.

SMARTER WI-FI[5]

There is a smarter way for mobile operators to leverage Wi-Fi. A smarter solution would actually use Wi-Fi to improve indoor coverage while offloading Internet traffic from the macro network.

In effect, Wi-Fi access points in the home or office would be turned into mini-cell towers, indoor extensions to an operator's mobile network. Thus, mobile operators would improve indoor coverage while gaining additional capacity from Wi-Fi.

A smarter Wi-Fi solution would provide a secure, trusted connection to smartphones over Wi-Fi so the operator's most valuable voice and SMS services can reach subscribers over any broadband network.

For subscribers, this smart Wi-Fi solution would result in dramatically improved indoor coverage, using the Wi-Fi which already exists in the home or office.

The technology has been standardized in the 3GPP's Release 6 specifications and is known as UMA/GAN. Commercial services based on the UMA/GAN specifications are available today.

[1] http://www.pcworld.com/article/184067/80211ac_standard_will_bring_gigabit_speeds_to_wifi.html
[2] http://www.wired.com/gadgetlab/2011/02/ubertooth-one-a-bluetooth-network-hacking-tool-on-kickstarter/?utm_source=feedburner&utm_medium=twitter&utm_campaign=Feed%3A+wired%2FFgiC+(Wired+Gadget+Lab)
[3] http://research.microsoft.com/en-us/projects/creds
[4] http://www.businessinsider.com
[5] http://www.wirelessweek.com

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